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PM FEATURES VOLUME 188 NO. 6



Writer Matt Hendrickson (left) and a pal stalk clay pigeons at Georgia's Cabin Bluff.

62 Is Fusion Finally for Real? After tantalizing—and frustrating—scientists for decades, fusion is emerging as a potentially game-changing energy. But is "limitless" power attainable? **BY ELIZABETH SVOBODA**

70 The New Energy Crisis: 10 Fixes Unrest in the Middle East, Japan's nuclear disaster, superhigh gas prices: PM proposes real-world solutions to our power problems. **BY ALEX HUTCHINSON**

74 High-Mileage Test Forget yesteryear's cramped econoboxes—today's high-mpg gasoline-powered cars have legroom (and speed) to spare. We test the best new little rides on the road. **BY JOHN PEARLEY HUFFMAN**

78 The Great Outdoors The way we see it, you cruise, you lose. So stop the adventure goose chase and check out a multisport base camp. PM heads to the Georgia coast for a shooting, boating and fishing excursion, and highlights three other destinations where one activity is never enough. **BY MATT HENDRICKSON**

86 When the First Responder Is You After you dial 911, what next? In the critical minutes before professional help arrives, you could save lives. Our experts tell you how to administer CPR, rescue a drowning victim, save someone from a burning car—and go from bystander to hero. **BY KALEE THOMPSON**



On the cover

The new energy crisis is deeper and more complex than any we've experienced in the past. But there are also more solutions at hand than ever before. Don't get mad, get informed—and take charge. **Illustration by Dogo.**

PHOTOGRAPH BY **SARAH SHATZ**

ILLUSTRATION BY DOGO

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DEPARTMENTS

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Tech Watch

11 Decimal Point Break Using science to build a better surfboard. **Plus:** A humanoid robot that walks just like, well, a human; how Japan's earthquake changed the planet; harnessing energy from sunlight, ocean waves and molten rock.

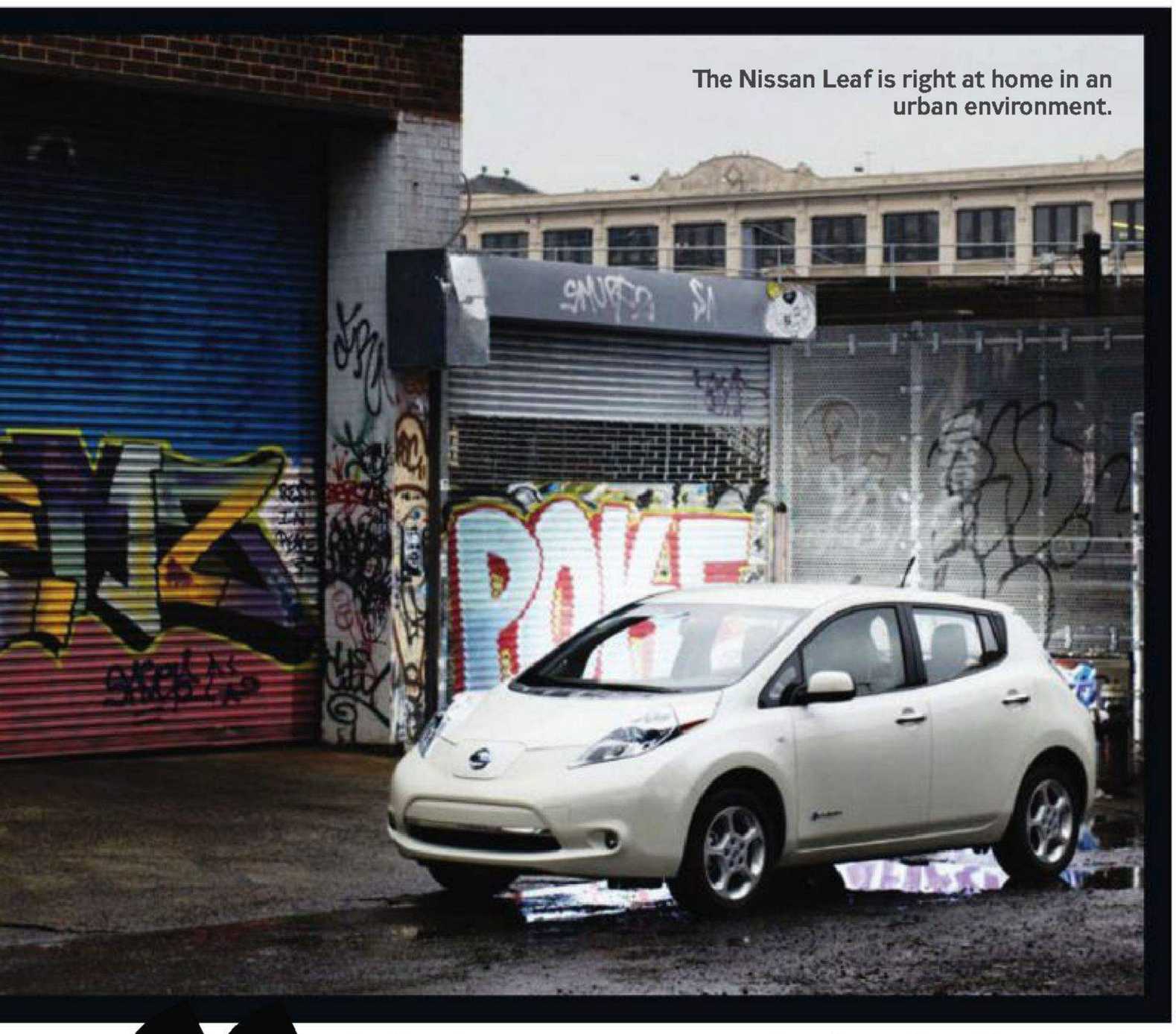
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21 Blades of Glory The Ridgid TwinBlade Saw uses two counter-spinning blades for added stability and control, cutting wood, pipe, sheet metal and more. **Plus:** Are pricey 3D glasses worth it? We put them to the test. Also, best gifts for a dad or a grad.

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33 GTI Squared VW's speedy GTI gets even speedier with the R version's debut. **Plus:** Ford's Raptor makes itself more useful; a 691-hp Lambo, the nimble Mazda5 minivan and more.

48 Long-Term Test Cars The Jeep Grand Cherokee Overland joins our fleet—and battles a Midwestern blizzard. **Plus:** We get a charge out of driving the all-electric Nissan Leaf.



The Nissan Leaf is right at home in an urban environment.

"The line between our cars and gadgets is collapsing fast. After three weeks with the Nissan Leaf, we're getting used to plugging in our vehicle just like our cellphones and iPads." — *Long-Term Test Cars, page 55*

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56 Was the Shuttle Worth It? As NASA retires the shuttle after years of triumphs and tragedies, PM editor-in-chief Jim Meigs calls for a new approach to space exploration.

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Home

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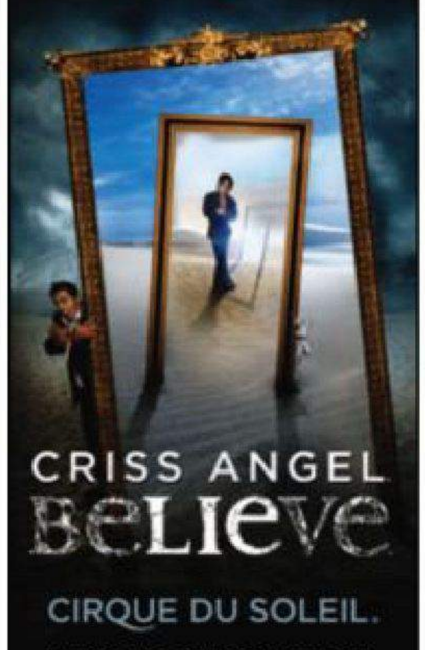


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PM'S FIRST-EVER HOME SAFETY WORKSHOP
Meet the experts and disaster pros at Houston's Reliant Center June 4 for a workshop on protecting your home and family during house fires, floods and other disasters. Special guests include PM editors and Cody Lundin, star of the Discovery Channel's *Dual Survival*. To sign up, go to ***popularmechanics.com/homesafetyshow***



TECH VS SHARKS Learn about man's best tools for thwarting the ocean's perfect killing machine, including steel-mesh shark suits that reduce injury if a fishy predator catches you in its jaws. ***popularmechanics.com/sharkattack***

LIFESAVER OR LIABILITY? A personal locator beacon might be an outdoorsman's most important piece of equipment. But are people using them frivolously, putting lives at risk by summoning search-and-rescue teams to nonemergencies? ***popularmechanics.com/beacon***

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PM Breakthrough Awards Update

CATCHING UP WITH

Dr. Anthony Atala

WAKE FOREST INSTITUTE FOR REGENERATIVE MEDICINE

In 2006, POPULAR MECHANICS presented Dr. Anthony Atala and a colleague with a Breakthrough Award for their lifesaving work growing human bladders in the lab and implanting them in patients. The surgeon made history again last year by engineering miniature livers from human cells. Then, in March, the team announced that patients who had received lab-engineered urethras had completed a successful six-year followup period. We talked to Atala about what his recent work means for patients and the future of organ replacement. — *ALLIE HAAKE*

PM: Transplants have become familiar, and devices such as pacemakers help damaged organs function better. How does the ability to grow organs and tissue change what's possible in medicine?

AA: More than 110,000 people are currently on U.S. transplant waiting lists, and even when a patient gets a donor organ, the body's natural response is rejection. Our process allows us to use the patient's own cells. We're very happy with the advances we've made. It's much harder to build a liver than a bladder, because the liver is a solid organ. We actually have to preserve the blood vessel tree and perfuse it with cells. We still have a lot of work ahead of us, but in the future, I think we'll be able to build most solid-organ systems—even the brain.

For more, visit popularmechanics.com/atalainterview.



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PM LETTERS



If she weren't selling some of the most exquisite jewelry in the world, PM reader Laura Curtis of New York City says she'd probably be a helicopter pilot or mechanic. "Fashion mags? No, thanks. PM is the only magazine I subscribe to. I love learning how things work."

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Hey, Now That's Extreme!

Your April article "Extreme How-To" about performing daring and difficult tasks was fun to read all the way through, but one item in particular—How to Lasso a Bull—took me back. When I was a young man, I worked in a small zoo in Greenville, S.C. One day, the lion escaped, and I just happened to be the fastest runner on the scene. I was able to catch up to him—but only after he had tangled himself up in some vines. I took off my belt, carefully looped it around his mouth and tightened it into a makeshift muzzle. Now what? Fortunately, there were others behind me who helped net the lion and take him back to the zoo. Still, it was an extreme situation, for sure. Thanks for a great article.

WILLIAM PATTERSON *SILER CITY, NC*

My husband is a mechanical engineer—and something of a know-it-all—so I enjoy stumping him with unexpected knowledge of my own. While I don't think I have the gall to try all the tasks in your article, it's still nice to know how to stunt-jump a car and use an underwater chain saw. The next time I meet someone at a social event, I'll ask him if he knows how to roll a stunt plane. Imagine his surprise when I tell him how!

CLAIR LISTON *GROSSE POINTE, MI*

Logging Criminal Activity

I liked your April column "The Antisocial Network," which describes how police officers track criminal activity on sites such as Facebook and Twitter. I'm shocked at how foolish people can be. For instance, posting videos of themselves holding illegal weapons on YouTube to intimidate their enemies? I almost can't believe it! But it is nice to know that as social networking becomes more prevalent, police forces are adjusting their criminal-investigation strategies.

JACOB WYNER *WOODBRIDGE, CT*

Did You Hear the One About the Really Fast Car With No Pistons?

I loved Jay Leno's column "Almost the Future," about the 1963 Chrysler Turbine. I've been fascinated with the car ever since it appeared at the 1964 New York World's Fair. Did you know that if not for a failed transmission, it could have won the Indy 500 in 1967?

JEFFREY COPPAGE *FARMINGTON, CT*

From our fans and followers



Hello, PM readers who use Facebook and Twitter—and thank you for commenting on our stories. Here are a few recent tweets and posts:

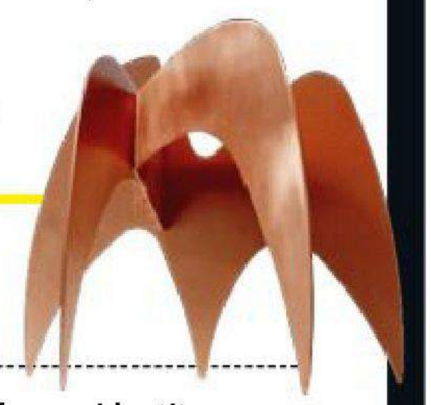
I love the newest edition of PM! Especially the piece on how to build an impromptu bomb shelter, and the Tetris studies.
JESSICA ALEKSANDROWICZ, VIA FACEBOOK
(Tech Watch, April '11)

I wouldn't mind building a jet, but my garage is too small :)
JOHAN BRAND, VIA FACEBOOK
("How to Restore a Harrier Jump Jet," popularmechanics.com)

Good read in @PopMech on the @Fiat 500.
@ARASHSHIRAZI, VIA TWITTER
("2011 Fiat 500 Test Drive," popularmechanics.com)

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Exciting news! POPULAR MECHANICS was nominated in April for a National Magazine Award (NMA), also known as an Ellie, for General Excellence. We're very proud to be recognized, since the annual awards are like the Oscars of the magazine industry. In March, our iPad app received a Mobile Edition nod, so we're on a roll! The Ellies (see statuette, right) will be handed out in May.

What do you think?

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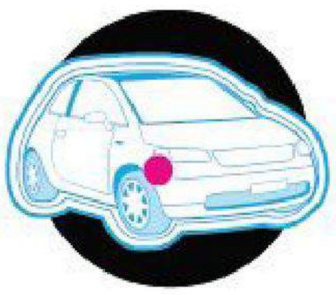
Tech Watch

• MODERN MEDICINE

Cancer Velcro

Cancer often spreads through elusive circulating tumor cells (CTCs) that travel in the blood. Medical researchers at UCLA have developed a layer of tiny silicon pillars coated in antibodies that can extract CTCs from blood for identification—what the investigators call a liquid biopsy. Initial tests with prostate cancer patients show that the technique is faster and more sensitive than other methods, making it ideal for early detection of metastasizing cancers.

• QUICK HITS



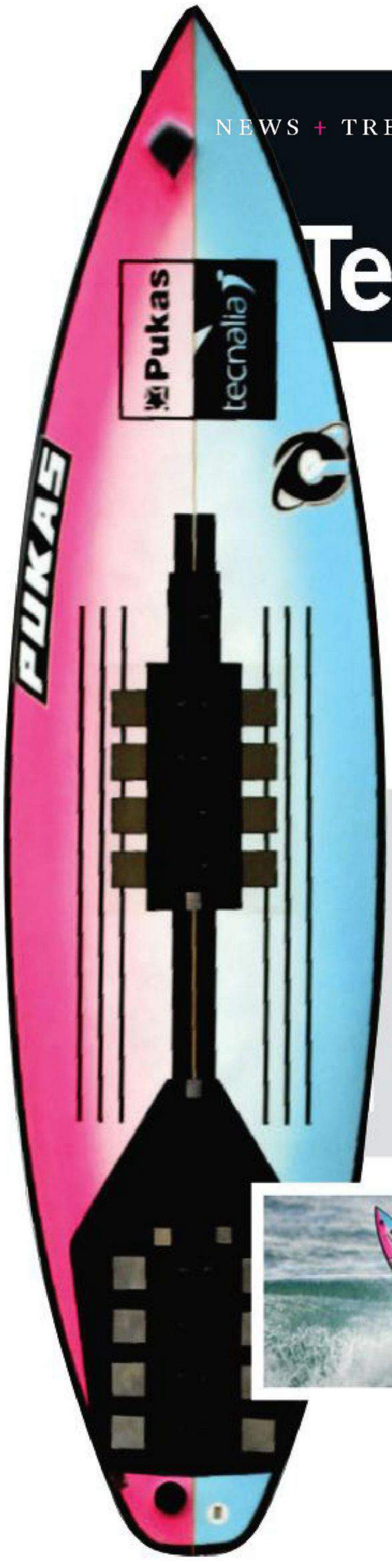
CARS WITH AN ELECTRIC GLIDE

Piezoelectric-energy-scavenging devices, which turn vibrations into electricity, are a popular area of energy research. But most people don't think to use them the other way around—applying electricity to create vibrations. Staff at Germany's Fraunhofer Institutes have replaced rubber parts that connect the metal frame of a car and its chassis with piezoceramic ones that generate real-time vibrations, counteracting the vibrations coming from the engine and the road to produce a quieter ride. The oscillation-damping bearings are being tested on a VW Passat this year.

PERFECTLY ORGANIC LIGHTS

Today's organic light-emitting diodes (LEDs), made from mostly carbon-containing molecules, still require expensive precious metals to generate light. New crystals, designed by University of Michigan researchers, use inexpensive carbon, oxygen, chlorine and bromine, making them the first LEDs made from purely organic compounds. They also have no trouble generating the color blue, a notorious weakness of current organic LEDs.

ILLUSTRATIONS BY JULIAN HONORÉ, PARS/E



• SCIENCE AT PLAY

Decimal Point Break

Researchers in Spain have loaded a high-tech surfboard with sensors that they hope will "turn feelings into facts and figures." A slew of instruments—which together weigh less than 2 pounds—transmit data wirelessly from the board to an onshore computer for real-time monitoring. Tecnalia Research & Innovation and surfboard manufacturer Pukas hope to use data collected from professional surfers to make stronger, more responsive surfboards. — *ALEX HUTCHINSON*



Accelerometer
→ Relays the gravitational forces imposed on the board; a tight turn can generate 5 g's.

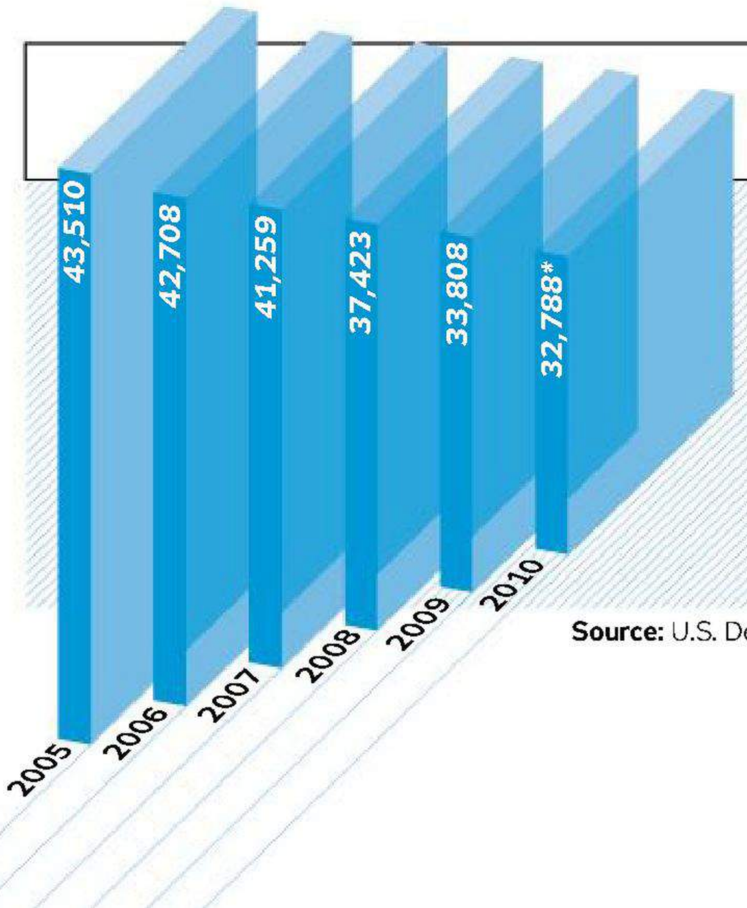
GPS
→ Uses satellites to pinpoint the board's location and track its speed.

Gyroscope
→ Determines orientation, including the angle of the board as it carves through water.

Strain Gauges
→ Measure the flex of the board during maneuvers.

• ROAD SAFETY

More Driving, Less Danger



Driving fatalities dropped 25 percent over the past five years, and last year's statistic is projected to be the lowest since 1949. The fatality rate is falling despite an increase in driving of more than 20 billion vehicle miles between 2009 and 2010. The American Highway Users Alliance notes that many safety features voluntarily introduced in the last two decades, such as electronic stability control, are now ubiquitous.

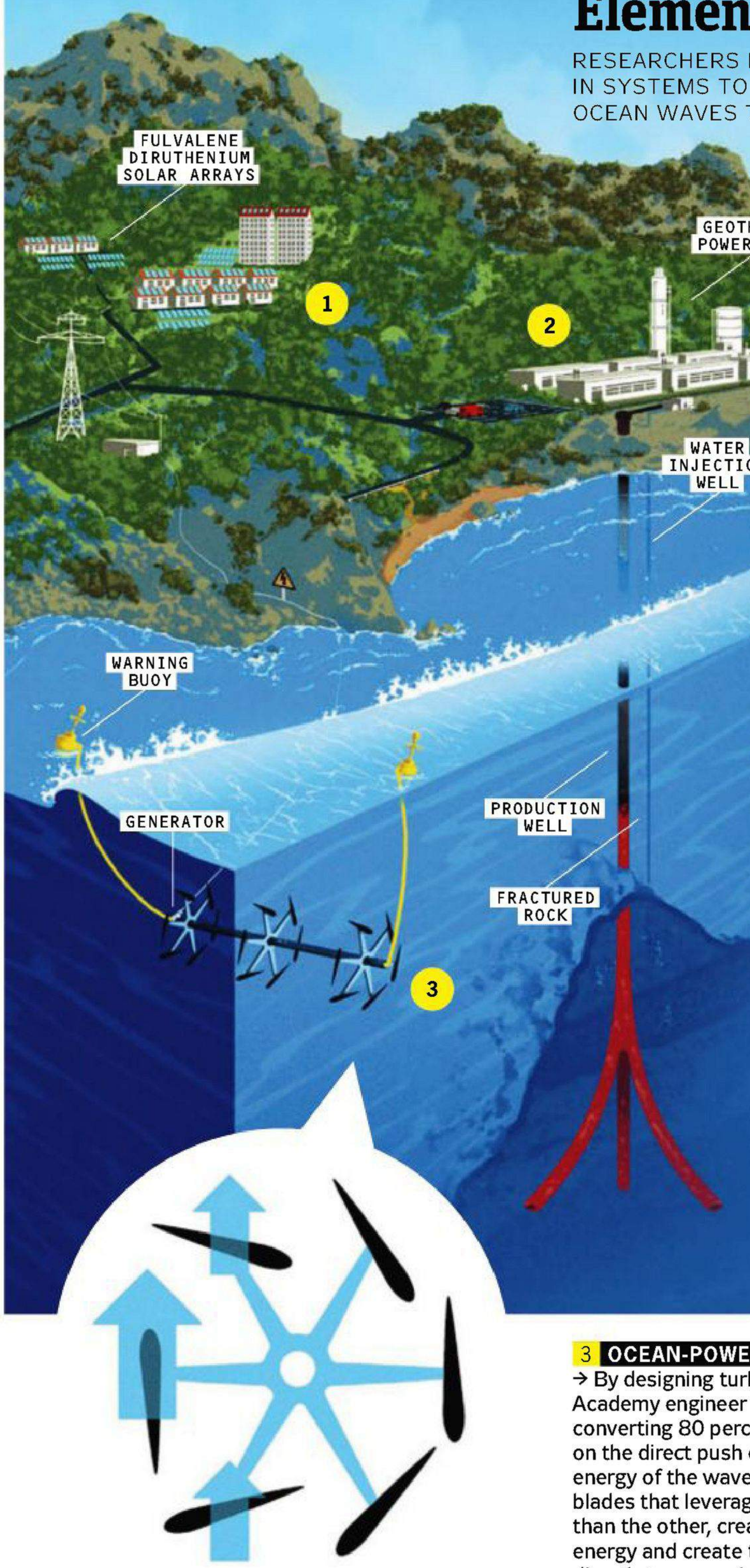
Source: U.S. Department of Transportation. * DOT projection based on raw data from several sources.

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RESEARCHERS MAKE IMPORTANT BREAKTHROUGHS IN SYSTEMS TO CONVERT SUNLIGHT, MOLTEN ROCK AND OCEAN WAVES TO ENERGY.



1 BOTTLED SUNLIGHT

→ Photovoltaic cells convert sunlight into electricity, while solar-thermal systems harness the sun's heat. University of California, Berkeley, chemist Peter Vollhardt has designed a material that combines the two approaches, trapping light energy and storing it until it is released on demand as heat. The material, fulvalene diruthenium, has an atomic structure that changes shape when exposed to light, a reaction Vollhardt compares to loading a spring. A small amount of heat or a chemical catalyst prompts the molecules to snap back to their original state, emitting energy. Vollhardt's team is now developing a rechargeable heat battery. "My dream is to heat a cup of espresso with California sunlight," he says. — *LOGAN WARD*

2 FIRE DOWN BELOW

→ A joint U.S.–Icelandic drilling team went looking for high-temperature water near an Icelandic volcano in 2009, hoping to tap the ground for a geothermal well capable of generating 8 megawatts of power from 570 F steam. But less than halfway to their projected 15,000-foot depth, red-hot magma entered the well, forcing the team to stop drilling. It turned out to be a lucky break: The magma produced a flow of 750 F dry steam, which, applied to a turbine, could generate 25 Mw of electricity—enough to power 30,000 homes. The researchers are now seeking other shallow sources of magma as potential energy. — *ALEX HUTCHINSON*

3 OCEAN-POWER BOOST

→ By designing turbine blades to imitate the wings of airplanes, U.S. Air Force Academy engineer Stefan Siegel has created an ultraefficient water turbine capable of converting 80 percent of a wave's energy to usable power. Typical water turbines rely on the direct push of the water, or drag, but that method can waste half the potential energy of the wave's motion. The Cycloidal Wave Energy Converter has two hydrofoil blades that leverage Bernoulli's principle: They force water to flow faster over one side than the other, creating lift on the low-pressure side. "As they rotate, they absorb energy and create torque at the shaft," Siegel says. "We can hook up a generator directly to our main shaft, without a complicated power-takeoff system. That increases efficiency." Siegel estimates that a future ocean system could power 4500 homes. Department of Energy–funded testing begins in August. — *SARAH FECHT*

ILLUSTRATION BY **RUI RICARDO**

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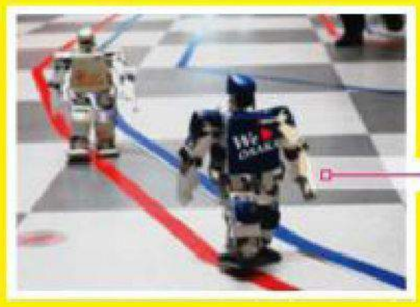


THE TRAILBLAZER
➡ Researchers plan to optimize the Petman android (left) to navigate rough terrain with unprecedented agility. The robot may even ultimately be able to swing from one handhold to the next like a human.

MACHINES ON THE MOVE

Balancing Act

The biggest challenge for walking robots used to be staying upright. Now, Boston Dynamics has two four-year DARPA contracts to make its Petman android prototype as agile as its human creators. Most robots utilize static stability, always keeping their center of mass directly over the support provided by their legs. But to move quickly, the new robot, called Atlas, will practice dynamic stability—instead of reacting to motion, the robot will anticipate how the step changes its balance and compensate by swinging its arms or adjusting its feet. Boston Dynamics will use Atlas and four-legged robots, such as BigDog (a 2006 PM Breakthrough Award winner) and Cheetah (built to run at least 30 mph), to study robot mobility. Future dynamically stable rescue robots could climb through rubble or crawl into tight spaces to assess building damage or search for survivors. — *DAVID HAMBLING*



Off to the Robot Races

➡ After 54 hours of competition, Robovie-PC prevailed by the slimmest of margins—just 1.7 seconds—in the first-ever robot marathon, held in Osaka, Japan. Five bipedal robots started the 26.2-mile race, but just two finished all 423 laps. It was a contest of endurance over speed: Support crews changed batteries and cooled motors with compressed air, but the robots had to pick themselves up when they fell. — *A.H.*

LABORATORY ADVANCES

During Surgery, the Beat Goes On

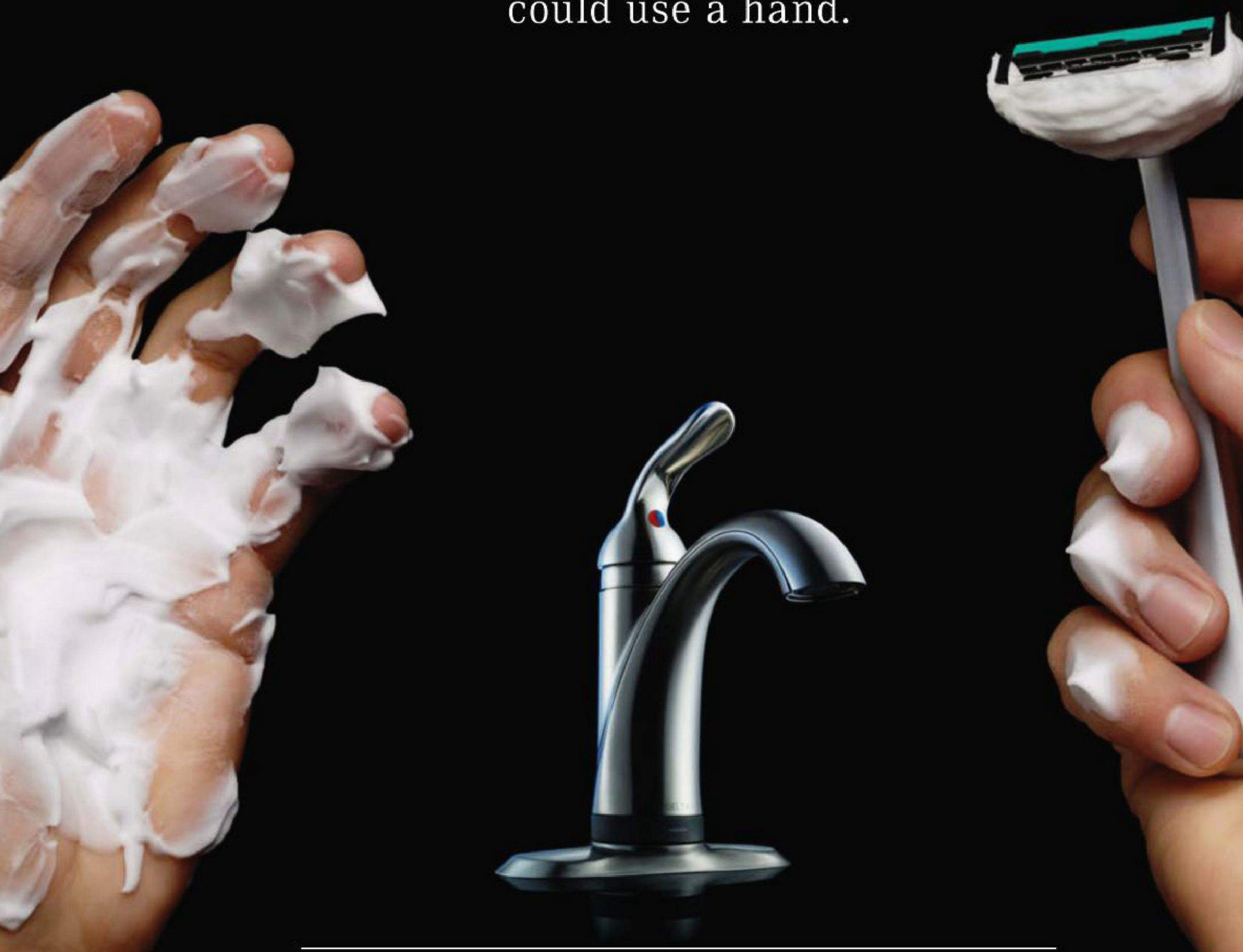
➡ One of the riskiest parts of open-heart surgery is that doctors have to stop the organ and send the patient's blood through a bypass machine, potentially causing heart and brain damage. Researchers at the German Aerospace Center have added motion compensation to a three-armed surgical robot, which may allow surgeons to operate directly on a beating heart. A stereo camera on one of the remote-controlled arms monitors the heart's movement; that data is processed and displayed to the doctor as a motionless image, allowing him or her to precisely guide surgical tools. The technology remains at least several years from appearing in hospitals. — *A.H.*

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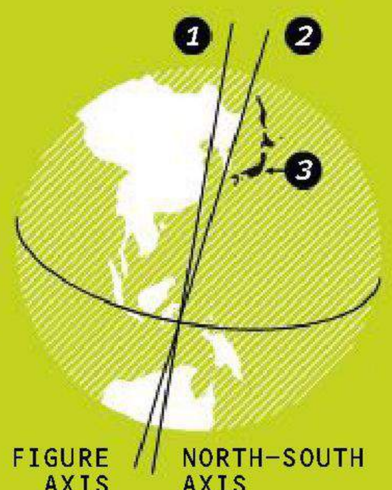
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EARTHQUAKE'S AFTERMATH

The Day the Earth Heaved

The colossal 9.0 earthquake in Japan shifted enough mass to make Earth rotate faster. Richard Gross, a geodynamics scientist at NASA's Jet Propulsion Laboratory, compares the phenomenon to a spinning ice skater. "She moves her arms closer to her body, moving her mass closer to the axis about which she's rotating," he says. "Earthquakes do the same thing." The stronger the quake, the greater the Earth's deformation and its effect on rotation. Gross calculated a 6.7-inch shift in the axis around which Earth's mass is balanced—twice that caused by the quakes under the Indian Ocean in 2004 and in Chile in 2010. Though the consequences of such a shift are mostly negligible, it can affect spacecraft navigation. Even a tiny change in the angle at which a spacecraft leaves Earth could mean a large guidance problem across tens of millions of miles. — *ANDREW MOSEMAN*



HOW EARTHQUAKES AFFECT TIME

1 The north–south axis runs through the poles.
2 The Earth's mass balances around its figure axis, which is about 33 feet off of the north–south axis.
3 The March 2011 Japanese quake shifted the Earth's figure axis by 6.7 inches.

As a result, a day is now 1.8 microseconds shorter. (One microsecond equals one-millionth of a second; a human-eye blink takes 350,000 microseconds.)

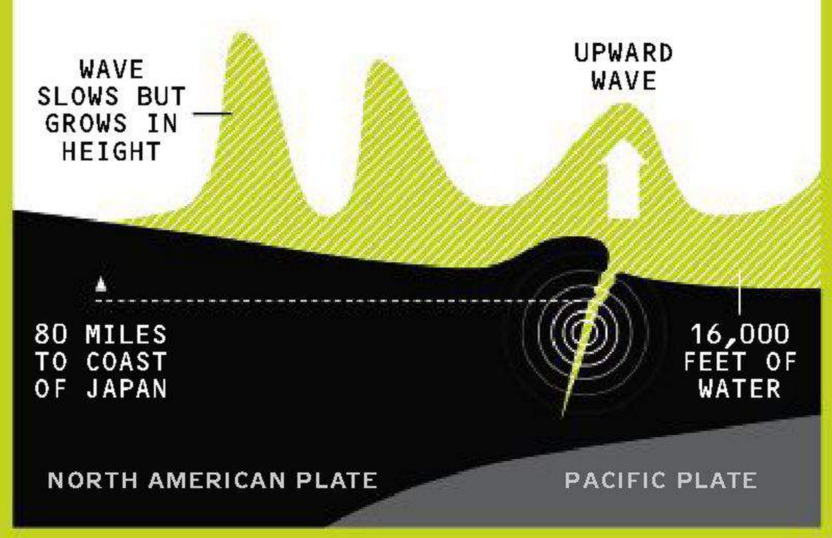
DISASTER BY THE NUMBERS

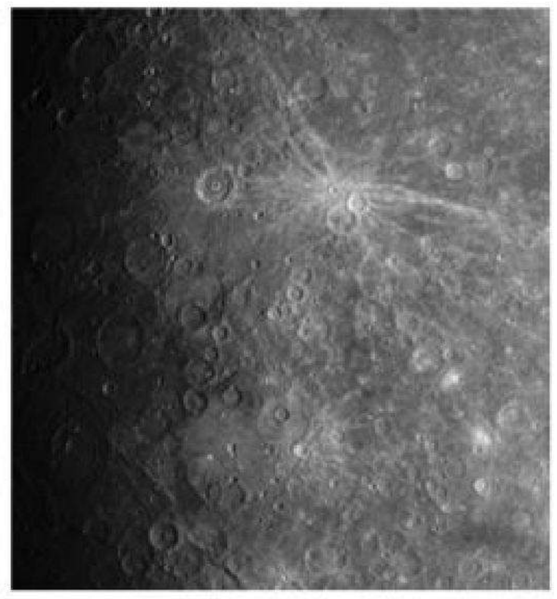


7.9 FEET
Distance Honshu Moved East After the Quake ➡ The Pacific continental plate is sliding beneath the North American plate, causing tension. When this pressure was released in March, the land surged upward and east, causing a massive earthquake and shifting the location of Honshu.
— *ALYSON SHEPPARD*

19.9 MILES
Depth of Earthquake
➡ During the quake, the ocean floor jutted up about 130 feet and slipped over an area about 185 miles long and 90 miles wide. This thrust the water column upward, generating one tsunami that traveled east to California and another that headed west to Japan.

500 MPH
Velocity of Tsunami
➡ In the open ocean, the tsunami wave nearly reached the speed of a commercial jet airliner. The wave slowed as it approached the coast, but the slope of the continental shelf boosted the wave's maximum height to 121 feet.





Circling Mercury

NASA's Messenger probe completed a 6.5-year, 5 billion-mile journey to Mercury in March. The spacecraft, the first to enter Mercury's orbit, will spend a year studying the innermost planet in our solar system.
— *STEVE ROUSSEAU*

Why Mercury? Scientists are intrigued by Mercury because it has a metal-rich core that accounts for about 60 percent of the planet's mass, twice that of our solar system's other terrestrial planets—Venus, Earth and Mars.

How did Mercury form? There are three competing theories, Messenger principal investigator Sean Solomon says. One proposes that the planet, as it formed from a disk of material spiraling around the sun, retained metal while slower-moving rock-dust particles fell into the sun. A second theory states that Mercury developed while surrounded by super-heated gas that vaporized its crust and much of its mantle. The third holds that a collision stripped the planet of much of its surface, leaving a metal core and mantle much later.

How can this probe settle the debate? Each theory would leave forensic clues that the probe can identify from orbit. Messenger's array of spectrometers will determine the composition of minerals on Mercury's surface.

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MODERN WARFARE

Pilots Over Libya, in Their Own Words

Combat came fast to the U.S. airmen called to perform the earliest missions over Libya this March. "Our ears perked up when the U.N. Security Council resolution was kicking off," says Axle, a 27-year-old F-15E Strike Eagle weapons system officer and one of the first airmen to participate in Operation Odyssey Dawn. (The Air Force asked PM to identify airmen only by their call signs.) "It did happen quick, but we're prepared to handle these things." On March 17, the United Nations council voted to establish a no-fly zone and use aircraft to form a protective cordon between rebels and the quickly advancing military of Libyan dictator Muammar Gaddafi. Within the week, Axle and his pilot, call sign Slam, flew from RAF Lakenheath, a British air base that hosts the 48th Fighter Wing, to Aviano Air Base in Italy. There they joined a cadre of French and British aircraft in sorties over defended Libyan airspace. "[In England] we support exercises for both the Air Force and NATO," Slam says. "It almost doubles the workload. But when something like this pops up, we've been training for it." Strike Eagles from Aviano destroyed radar stations, antiaircraft missiles and ground forces in armored vehicles. The pilots attacked targets, such as the radar sites, according to a strategic plan, but at other times they struck Gaddafi loyalists who were taking aggressive action against other Libyans. It took three days to reduce the antiaircraft defenses and form a no-fly zone. "During the flight briefings we find out specifically what we'll be striking that day," Axle says. "After that, we 'step to fly' and then go make it happen." — *JOE PAPPALARDO*



F-15E Strike Eagle

Weapons: Air-to-ground bombs, rockets and missiles; 20-mm cannon.
Targets: Radar sites, surface-to-air missile launchers, command-and-control hubs.
Tactic: Fly high and use precision weapons.



A-10 Thunderbolt II
("Warthog")

Weapons: 30-mm automatic cannon; AGM-65 Maverick missiles.
Targets: Tanks, armored personnel carriers, coastal patrol ships.
Tactic: Swoop in low to fire cannon at close range.

> "The 81st Fighter Squadron just got back from Afghanistan, so we were already on a war footing. They told us where to go, and we were there in a couple of days." CAB, USAF A-10 PILOT



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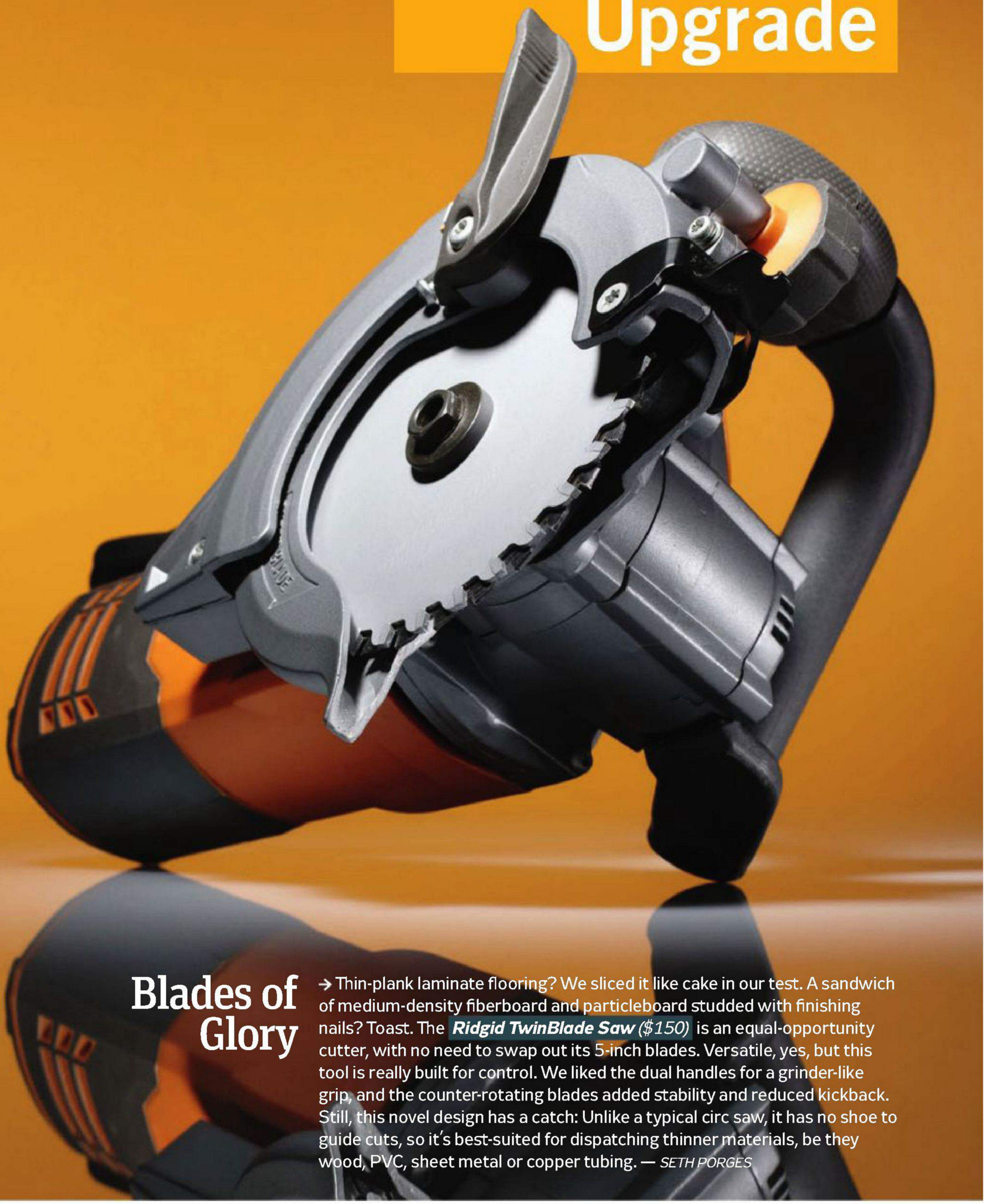
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Upgrade



Blades of Glory

→ Thin-plank laminate flooring? We sliced it like cake in our test. A sandwich of medium-density fiberboard and particleboard studded with finishing nails? Toast. The ***Ridgid TwinBlade Saw*** *($150)* is an equal-opportunity cutter, with no need to swap out its 5-inch blades. Versatile, yes, but this tool is really built for control. We liked the dual handles for a grinder-like grip, and the counter-rotating blades added stability and reduced kickback. Still, this novel design has a catch: Unlike a typical circ saw, it has no shoe to guide cuts, so it's best-suited for dispatching thinner materials, be they wood, PVC, sheet metal or copper tubing. — *SETH PORGES*

PHOTOGRAPH BY **DEVON JARVIS**

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Remaking Beds

→ Few things signal a well-maintained yard like a fresh edge on a garden bed. But keeping edges clean usually requires cutting a line with a shovel—and who has time for that? The ***Echo BRD-280 Bed Redefiner ($600)*** makes precision edging as simple as using a string trimmer—its 28.1-cc engine provides the muscle for a six-fingered steel-and-carbide-tipped claw that does the dirty work for you. A single-purpose power tool at this price may be of most interest to professional landscapers, but we're not going to deny that our gardens could use a touchup.





Double-Bag It

↑ Most sleeping bags are designed to handle only a narrow range of conditions, so the one that works for you in August could be inadequate come October. The ***Mountain Hardwear Down Flip 35/50 Sleeping Bag ($175)*** features a rating for a mild 45 degrees F on one side, while the flip side provides heavier insulation that ratchets up the warmth as the mercury edges down to 35 F.

4G SHOWDOWN →

AT&T vs T-Mobile

We sometimes wonder if this 4G thing could be any more confusing. There's no formal definition of what constitutes a 4G network, so the four major carriers have taken to applying the gee-whiz term to three different technologies. Not complicated enough for you? Consider this: One 4G tech, the HSPA+ used by AT&T and T-Mobile, is really just an upgraded version of old 3G networks. HSPA+ should prove to be no more than stopgap tech: At press time, AT&T and T-Mobile were knee-deep in merger talks, and AT&T was promising to roll out a more powerful LTE 4G network. Still, we couldn't help but wonder how well the HSPA+ networks live up to their 4G billing, so we put them through a series of tests in the New York area. *BY GLENN DERENE*

	AT&T	T-MOBILE
		
TESTED PHONE	HTC Inspire 4G	T-Mobile myTouch 4G
DOWNLOAD SPEEDS	**AVG.** 2.03 Mbps* **MAX.** 3.07 Mbps ✓	**AVG.** 0.81 Mbps **MAX.** 1.33 Mbps
UPLOAD SPEEDS	**AVG.** 0.29 Mbps **MAX.** 0.43 Mbps	**AVG.** 0.87 Mbps **MAX.** 1.39 Mbps ✓
MEDIA PERFORMANCE	High-resolution YouTube videos buffered within seconds and played without a blip. ✓	The same high-res videos were inconsistent on the myTouch. Some loaded fast and played smoothly, others choked and stuttered.
MOBILE HOTSPOT	High-res YouTube and Netflix videos played with a minimum of glitches, and Web surfing was on par with home broadband. Cost: $25/month ✓	Web surfing was fast, but high-resolution videos played in fits and starts. Lower-res videos and music performed better. Cost: $10/month

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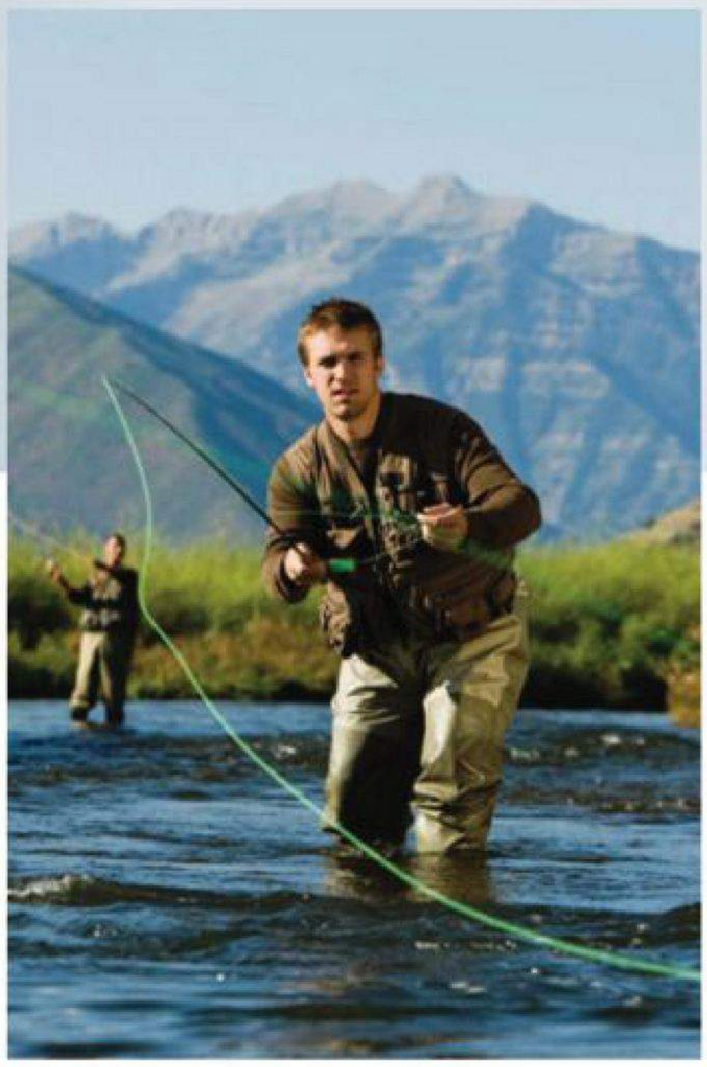
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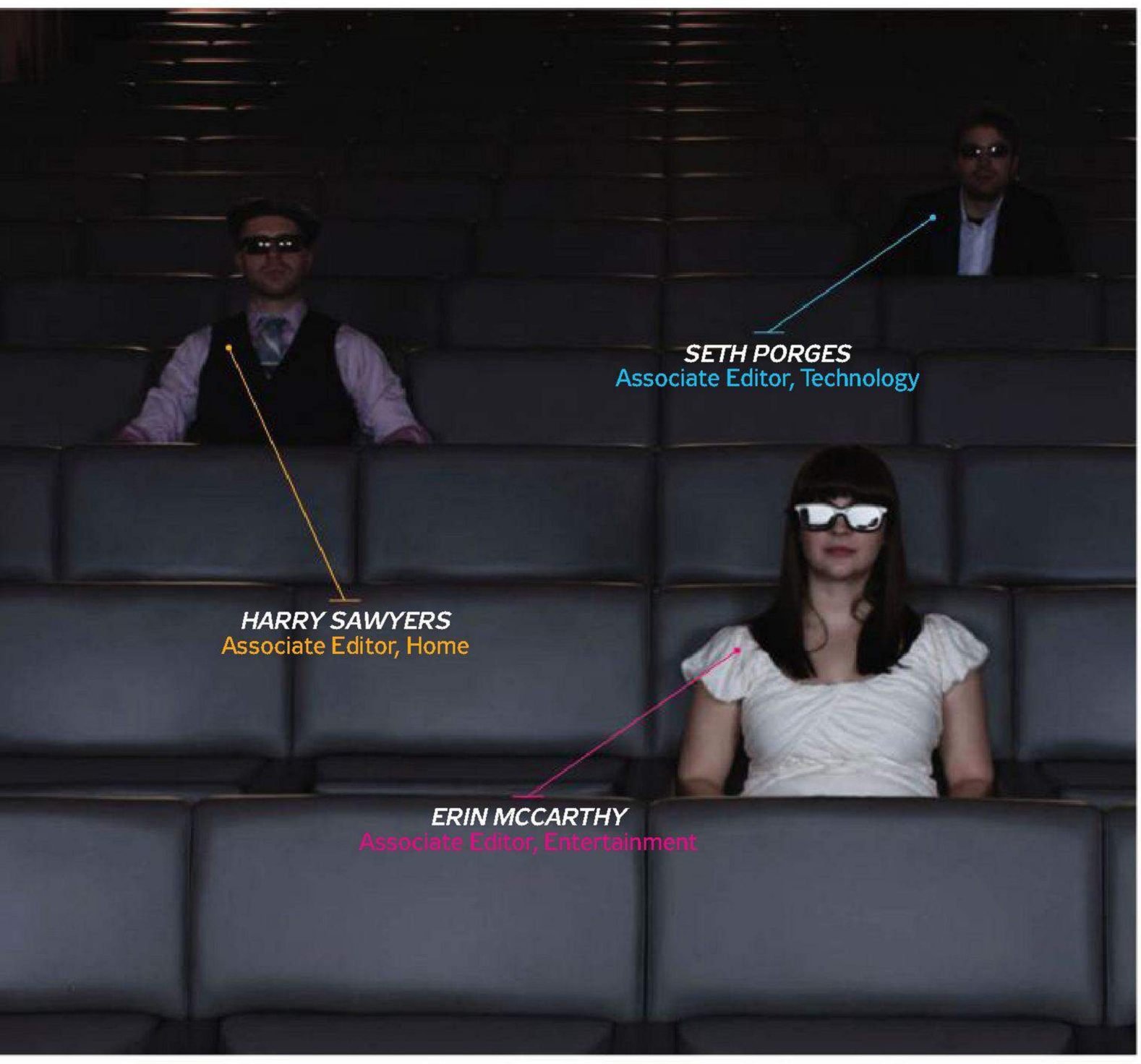
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PM FIELD TEST

3D Glasses

As if the $17 admission weren't enough, manufacturers are betting that consumers will shell out big bucks for their own 3D movie glasses. The promise: optics, comfort and style that put throwaway theater freebies to shame. But are the pricey specs worth it? To find out, I teamed up with two other PM editors to conduct a test at a screening of *Drive Angry 3D*—so you don't have to. Luckily, we weren't in search of cinematic excellence; we just wanted to judge how the glasses worked. ***BY SETH PORGES***





3D Experience

REALD: The free glasses had a very impressive 3D effect. "The depth was as good as any of the expensive pairs," says PM associate editor Erin McCarthy. But the flat lenses provided poor peripheral visibility, and one editor found the lenses to be a shade darker than the other pairs.

GUNNAR: Though the lenses produced an adequate 3D effect, we all found them to be a tad small. The frames encroached on our field of vision, and at the peripheries, all we could see was a 3D blur.

MARCHON3D: We all gave a thumbs-up to the large lenses, which completely encompassed our field of vision, giving us the most immersive experience. We were also unanimous in finding the glasses' 3D effect on par with that of the RealD control specs. The lone objection came from McCarthy, who says the "left lens seemed slightly darker than it should have been."

OAKLEY: We loved the Oakley's 3D performance. Still, no one was happy with the glare that the glossy white frames cast on the lenses. "It was hard to see popcorn through them," associate editor Harry Sawyers says. Fortunately, the Oakleys are also available with reflection-free black frames.

Fit and Comfort

REALD: While my colleagues found the free glasses surprisingly comfortable, I noticed that they had a tendency to slide down my nose. And then there's the general ickiness factor with theater-distributed glasses. I mean, who knows who else has worn them?

GUNNAR: The lightweight magnesium-aluminum-alloy frames felt the most luxurious, sitting almost imperceptibly on the nose. (The other frames in the test were plastic.) We all loved the flexible hinges, which provided a nice fit despite our differing head shapes and sizes.

MARCHON3D: Comfortable frames, a snug fit and large lenses made the Marchon3D the category winner. "I almost forgot I was wearing 3D glasses," Sawyers says.

OAKLEY: We all liked the fit, with one exception: McCarthy noted minor discomfort around her ears. "3D glasses are supposed to disappear, but I could really feel these," she says.

BOTTOM LINE Though the Marchon3Ds provided the best overall experience, it's hard to view any of these specs as a must-buy yet. Still, it's nice to see manufacturers getting ahead of the curve, and besides, these shades aren't just for theaters—they make a nice coffee-table complement to the new wave of 3D TVs, which use the same type of glasses as cinemas.

PHOTOGRAPH BY **DEVON JARVIS**

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PM GIFT GUIDE

DADS + GRADS

'Tis the season for Father's Day and college graduation.

But we would hate to see you resort to recognizing either with a necktie or a Starbucks card.

Here are a few slightly more interesting ideas—from classic to of-the-moment—that any dad or grad might appreciate.

BY SETH PORGES





DAD
There's a reason watches are go-to gifts: A good one lasts for decades. The 100-meter-water-resistant, stainless-steel ***Tissot PR100 watch ($275)*** is sturdy and quietly sophisticated, two things any dad can appreciate.

GRAD
The ***Phosphor E Ink Digital Hour Clock ($185)*** is the first watch to feature the Kindle tech's epic battery life and uncanny readability. Want to mix things up? Two modes let users switch between a numeric digital display and a graphic hour clock.



DAD Outdoor kitchens can be a *Cribs*-like expense, costing as much as a car. The ***Weber Summit Grill Center With Social Area ($4500)*** has the same slick look and functionality of comparable units at a slightly less insane price. And unlike built-in rigs, it requires no permits, plumbers or electricians.



GRAD
Thanks to its specialized inserts, the ***Stok Charcoal Tower ($150)*** can swap out its 22½-inch grill grate for a pizza stone, griddle or veggie tray.

PHOTOGRAPHS BY PHILIP FRIEDMAN (WATCHES, CAMERAS)

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DAD

The Fender Tele essentially defined the modern electric guitar. The new ***Fender 60th Anniversary Telecaster ($1900)*** retains the classic's look and sound—but you get to add the patina.



GRAD

The ***Misa Kitara Digital Guitar ($960)*** is the perfect ax for the *Guitar Hero* generation. Instead of strings, players strum a multitouch screen and press fret buttons. Detractors might call it a souped-up keytar, but this design makes it a cinch to nail notes and apply digital effects such as modulation, delay and distortion without the need for pedals or panels.

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PM GIFT GUIDE

DADS + GRADS



DAD

He may already have a digital camera, but part of any pop surely misses the charm of shooting film. Photos taken with the analog ***Lomography Sprocket Rocket ($90)*** bleed onto the film's sprockets (those tiny holes that line the sides), amplifying the old-school look.



GRAD

A digital SLR can be daunting for casual photographers. The ***Canon Rebel T3i 18-55mm IS II Kit ($900)*** has in-camera tutorials to help even novice shooters make the most of its many modes.

DAD

He's not giving up his motorcycle, so give him this: Allowing just 84 dB of ambient noise to creep in at 60 mph, the ***Schuberth C3 ($700)*** may be the quietest flip-face helmet on the market.





GRAD

While road racers obsess over extra ounces adding seconds to their runs, even casual bikers can appreciate a barely there helmet. At less than 8 ounces, the ***Giro Aeon ($240)*** is the lightest full-featured bike helmet yet.

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DAD

Pinball and the Rolling Stones are two things that many people wrongly assume are dead. The ***Stern Rolling Stones Pinball Machine ($4700)*** combines the two baby-boomer icons in one game-room-friendly nostalgia trip.



GRAD

It's on like Donkey Kong. The sci-fi style and spill-proof enclosure of the ***Stealth Arcade Table ($3300)*** conceal a preinstalled stash of 60 iconic arcade games and a bass-heavy speaker system that lets you crank the classic beeps and blips up and down. Ms. Pac-Man never looked—or sounded—so good.

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2012 VW GOLF R

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GTI Squared

VW's GTI, one of the tastiest driver's cars around, is about to double down. Sometime later this year, an enthusiast-focused R version will debut with a more powerful 2.0-liter turbo four-cylinder (for roughly 55 more hp than the GTI's 200), larger brakes, firmer suspension and a six-speed manual gearbox. To handle the extra power, all Rs will also have an all-wheel-drive system, which has the added effect of altering the weight balance slightly rearward. On the curvy roads outside Geneva, Switzerland, the R's composure trumped even the GTI's, something we didn't think possible. It bites into corners aggressively and perfectly balances both ends. Available in both two- and four-door bodies, the R is fabulously well-tuned, but there is a price to pay: about $33,000, or 10 grand more than a GTI.

— BEN WOJDYLA

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2012 Nissan Murano CrossCabriolet



NISSAN'S CROSSOVER CROSSES OVER Chopping the roof and removing two doors from Nissan's Murano crossover is not an idea that has crossed many minds. Yet Nissan recently introduced the CrossCabriolet, a tall, four-seat convertible, priced at $46,390, that the company expects will appeal to affluent middle-aged women. We don't know about the demographic, but based on a brief drive through the coastal suburb of Brentwood, Calif., the CrossCabriolet has some things going for it. Motivated by a 265-hp V6, this 5300-pound sun worshipper won't win over anyone looking for a sporty ragtop, because of its large footprint and elevated stance. But for a leisurely drive when the weather's right, we imagine there could be a small handful of folks who might find benefit in this oddball convertible that also boasts enough cargo capacity for two golf bags. *— BASEM WASEF*

2012 Mazda5



RIGHT-SIZED VAN The Mazda5 is about 2 feet shorter and 10 inches narrower than a conventional minivan, but it still has those handy sliding rear doors and three rows of seats. Inside, it's comparatively snug—naturally—but the kids won't miss the extra space. The parents will appreciate the great compromise between comfort and control, and the levels of refinement are good enough to provide a reassuring film of luxury between you and the gritty reality of modern travel. With accurate, tactile steering and nimble handling, it never feels like a minivan—until the doors are slid open and six people are securely seated. Plus, the 2.5-liter engine returns decent fuel economy (21/28) and is available with either a six-speed manual or five-speed automatic. A minivan with a stick? That's almost . . . cool. The Mazda5 isn't downsized, it's right-sized. *— BARRY WINFIELD*

Glass-Roof Roadster

The revised SLK draws inspiration from the SLS AMG supercar, but this roughly $50,000 roadster is far more attainable. Beneath its masculine skin, a new direct-injected 302-hp V6 and seven-speed automatic have been revised for snappier acceleration and thriftier fuel sipping. We enjoyed the SLK350's stiffer suspension and zesty performance while squirting around the Canary island of Tenerife, and were equally impressed with the Magic Sky Control roof, which switches the glass's tint from opaque to transparent at the touch of a button. Next year, the SLK250 arrives with a turbo 201-hp 1.8-liter four-cylinder that offers a lighter, nimbler package. *— BASEM WASEF*

2012 Mercedes-Benz SLK



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2011 Ford F-150 SVT Raptor SuperCrew



Wicked and Practical

The Raptor is an off-road terror, but consumers wanted more utility. So for 2011, the Raptor is available in the longer, four-door SuperCrew body style. In addition to extra rear-seat legroom, the Raptor SuperCrew boasts 8000 pounds of towing capacity (versus 6000) and carries 1030 pounds of cargo (a 100-pound improvement) and 36 gallons of fuel (up by 10). The standard 411-hp 6.2-liter V8 couples to a six-speed automatic with new SelectShift electronics, giving the driver full control of the gears. Similarly, a new 4.2-inch LCD between the primary gauges helps drivers choose among several modes of operation—the system works through a "truck app" controlled by a five-way switch on the steering wheel. SVT revised the suspension and steering gear to make the SuperCrew behave as much like the SuperCab as possible, and we only noticed the difference in tight quarters, where the extra length impedes maneuverability. *— KEVIN A. WILSON*

2012 BMW K 1600 GT



SIX APPEAL Having come close to perfecting the inline six-cylinder engine for cars, BMW has now installed a straight six in an all-new sport tourer, the K 1600 GT. This compact 1.6-liter motor is no wider than a typical four-cylinder, yet it spins with a creaminess few engines can match. Plus, its low-end grunt is prodigious, and the available 160 hp accelerates the 700-pound-plus machine with authority. BMW's control-arm front suspension and single-sided rear swing arm provide stability whether you're cruising in a straight line or leaned over, dragging metal in the twisties. The GT comes with traction control, linked ABS, cruise control and heated seat and grips, and is topped off with an innovative self-leveling headlight. An amalgam of visceral performance and luscious sounds, the $20,900 K 1600 GT is certain to redefine the boundaries of what sport touring is all about. *— JEFF BUCHANAN*

2012 Acura TL



AUTO RHINOPLASTY The TL's anvil-like nose visually detracted from what was otherwise a perfectly competent sport sedan, so the TL's front end and numerous other details have been updated for 2012. While the new visage is gentler on the eyes, the TL still doesn't turn heads like an Audi A4 or Cadillac CTS. Yet thanks to mechanical changes—sharper steering and snappier shifts from the six-speed auto—and high reliability and resale value, it remains a solid choice. The returning 3.5-liter 280-hp V6 for the front-driver ($35,605) and a 3.7-liter V6 good for 305 hp in the super-handling-AWD edition ($39,155) have been tuned for higher efficiency, and continue to deliver free-revving performance. Enthusiasts will want the SH-AWD model with the optional manual gearbox and 19-inch summer tires. It's eager and light on its tires—the best-handling of the bunch. *— MICHAEL FRANK*

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2011 Geneva Motor Show

Despite the fact that Switzerland has no automotive industry of its own, the Geneva Motor Show is arguably Europe's most important new-car event. As in recent years, the 2011 show was a fascinating dichotomy of exotic, mega-horsepower machines from Ferrari and Porsche and high-technology fuel sippers. Here's a sample of the new-car introductions. For more, visit popularmechanics.com. — *BASEM WASEF*

SAAB PHOENIX CONCEPT

Yes, Saab is still alive, and with the PhoeniX, the company is making a dramatic break from its recent conservative styling. As with all concepts, this one hints at the company's new design language—called aeromotional. A 1.6-liter turbo engine powers the front wheels, while an electric motor handles the rears.

VW BULLI CONCEPT

The Bulli is VW's second Microbus-inspired concept. This one is smaller than a current minivan, more like a Nissan Cube, and is electrically powered. The interior is clean and airy, with a slick gauge pack and an integral iPad dock serving as the center stack. Officially, the Bulli isn't set for production, but VW is clearly experimenting with ways to bring this design to market.



LAMBORGHINI AVENTADOR LP700-4

Although Lamborghini's Aventador LP700-4 maintains the Italian manufacturer's tradition of naming its flagship after a deadly bull, the low-slung supercar bears virtually no resemblance to the Murciélago it replaces. The Aventador is 200 pounds lighter than its tube-framed predecessor, thanks to a carbon-fiber monocoque chassis, and the 6.5-liter V12 belts out 691 hp.

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There is good news.

When taken once a day, every day, Cymbalta can help significantly reduce your chronic osteoarthritis pain or chronic low back pain. It is a non-narcotic, non-NSAID prescription medicine.

Did you know that your body has a natural pain-suppressing system that can help regulate the amount of pain you feel?

Although the exact way that Cymbalta works to reduce chronic osteoarthritis pain or chronic low back pain is unknown, it is believed that Cymbalta helps lessen pain by enhancing the body's natural pain-suppressing system by increasing the activity of serotonin and norepinephrine in the brain and spinal cord.

Visit cymbalta.com or call 1-877-CYMBALTA to learn more. Ask your doctor about Cymbalta.

Cymbalta is approved for the management of chronic musculoskeletal pain in people with chronic osteoarthritis pain and chronic low back pain.

Important Safety Information About Cymbalta

The most important information you should know about Cymbalta:

Antidepressants can increase suicidal thoughts and behaviors in children, teens, and young adults. Suicide is a known risk of depression and some other psychiatric disorders. Call your doctor right away if you have new or worsening depression symptoms, unusual changes in behavior, or thoughts of suicide. Be especially observant within the first few months of treatment or after a change in dose. Approved only for adults 18 and over.

Cymbalta® (duloxetine HCl) is not for everyone.

Do not take Cymbalta if you:

- have recently taken a type of antidepressant called a Monoamine Oxidase Inhibitor (MAOI) or Mellaril® (thioridazine)
- have uncontrolled narrow-angle glaucoma (increased eye pressure)

Talk with your healthcare provider:

- about all your medical conditions, including kidney or liver problems, glaucoma, diabetes, seizures, or if you have bipolar disorder. Cymbalta may worsen a type of glaucoma or diabetes
- if you have itching, right upper belly pain, dark urine, yellow skin/eyes, or unexplained flu-like symptoms while taking Cymbalta, which may be signs of liver problems. Severe liver problems, sometimes fatal, have been reported
- about your alcohol use
- about all your medicines, including those for migraine, to address a potentially life-threatening condition. Symptoms may include high fever, confusion, and stiff muscles
- if you are taking NSAID pain relievers, aspirin, or blood thinners. Use with Cymbalta may increase bleeding risk
- before stopping Cymbalta or changing your dose
- if you experience dizziness or fainting upon standing while taking Cymbalta. This is likely to occur in the first week or when increasing the dose, but may occur at any time during treatment
- about your blood pressure. Cymbalta can increase your blood pressure. Your healthcare provider should check your blood pressure prior to and while taking Cymbalta
- if you experience headache, weakness, confusion, problems concentrating, memory problems, or feel unsteady while taking Cymbalta, which may be signs of low sodium levels
- if you develop problems with urine flow while taking Cymbalta
- if you are pregnant or plan to become pregnant during therapy, or are breast-feeding

Most common side effects of Cymbalta (this is not a complete list):

- nausea, dry mouth, sleepiness, fatigue, constipation, dizziness, decreased appetite, and increased sweating

You are encouraged to report negative side effects of Prescription drugs to the FDA. Visit www.fda.gov/medwatch or call 1-800-FDA-1088.

Other safety information about Cymbalta:

Cymbalta may cause sleepiness and dizziness. Until you know how Cymbalta affects you, you should not drive a car or operate hazardous machinery.

How to take Cymbalta:

Take Cymbalta exactly as directed by your healthcare provider. Cymbalta should be taken by mouth. Do not open, break or chew capsule, it must be swallowed whole. Cymbalta can be taken with or without food.

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See back page for additional Information For Patients About Cymbalta, including Boxed Warning.

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Information For Patients About Cymbalta

Please read this information carefully before you, or your family member start taking Cymbalta (sim-BALL-tah), and each time your prescription is refilled, in case anything has changed or new information has become available. This information is not meant to take the place of discussions with your healthcare provider. Talk with your healthcare provider or pharmacist if there is something you do not understand or if you want to learn more about Cymbalta. Always follow your healthcare provider's instructions for taking Cymbalta.

What is the most important information I should know about Cymbalta?

Warning: In clinical studies, antidepressants increased the risk of suicidal thinking and behavior in children, adolescents, and young adults with depression and other psychiatric disorders. Anyone considering the use of Cymbalta or any other antidepressant must balance this risk with the clinical need. Short-term studies did not show an increase in the risk of suicidal thinking or behavior with antidepressants in adults older than 24; there was a reduction in risk with antidepressants in adults 65 and older. Suicide is a known risk of depression and some other psychiatric disorders. All patients starting antidepressant therapy should be monitored appropriately and observed closely. Families and caregivers should discuss with the healthcare provider right away any observations of worsening depression symptoms, suicidal thinking and behavior, or unusual changes in behavior. Cymbalta is not approved for use in patients under age 18.

Patients on antidepressants and their families or caregivers should watch for new or worsening depression symptoms, unusual changes in behavior, and thoughts of suicide, as well as for anxiety, agitation, panic attacks, difficulty sleeping, irritability, hostility, aggressiveness, impulsivity, restlessness, or extreme hyperactivity. Call your healthcare provider right away if you have thoughts of suicide or if any of these symptoms are severe or occur suddenly. Be especially observant within the first few months of treatment or whenever there is a change in dose.

What is Cymbalta?

Cymbalta is a prescription medicine that is approved to treat multiple conditions. Cymbalta is approved for the treatment of major depressive disorder (MDD), also called depression; generalized anxiety disorder (GAD); for the management of fibromyalgia (FM); the management of diabetic peripheral neuropathic pain (DPNP), also called diabetic nerve pain; and for chronic musculoskeletal pain, including the management of chronic pain due to osteoarthritis and chronic low back pain.

Who should NOT take Cymbalta?

You should not take Cymbalta if:

- You are taking a type of antidepressant known as a Monoamine Oxidase Inhibitor (MAOI), such as Nardil® (phenelzine sulfate), Parnate® (tranylcypromine sulfate), or Emsam® (selegiline transdermal system). Using an MAOI with many prescription medicines, including Cymbalta, can cause serious or even life-threatening reactions. You must wait at least 14 days after you have stopped taking an MAOI before you take Cymbalta. You need to wait at least 5 days after you stop taking Cymbalta before you take an MAOI
- You have uncontrolled narrow-angle glaucoma (increased eye pressure)
- You are taking an antipsychotic medicine known as Mellaril® (thioridazine)

What should I talk to my healthcare provider about?

Talk with your healthcare provider:

- About any medical conditions you may have, including kidney or liver problems, glaucoma, diabetes, seizures, or if you have bipolar disorder. Cymbalta may worsen a type of glaucoma or the control of blood sugar in some patients with diabetes
- If you have itching, right upper belly pain, dark urine, yellow skin/eyes, or unexplained flu-like symptoms while taking Cymbalta, which may be signs of liver problems. Severe liver problems, sometimes fatal, have been reported
- About your alcohol use
- If you are taking or plan to take any prescription or nonprescription medicines, as Cymbalta may interact with some of these products
- If you take medications known as triptans, commonly prescribed for migraines. A potentially life-threatening condition may occur when triptans are used with Cymbalta. Symptoms may include high fever, confusion, and stiff muscles
- If you take NSAID pain relievers, aspirin, or blood thinners, as these medications may increase risk of bleeding when used with Cymbalta
- Before stopping Cymbalta or changing your dose. Stopping Cymbalta may result in symptoms including dizziness, nausea, or headache (not a complete list). Your healthcare provider may wish to decrease the dose slowly
- If you are pregnant, plan to become pregnant, or are breast-feeding
- If you experience dizziness or fainting upon standing while taking Cymbalta. This is likely to occur in the first week or when increasing the dose, but may occur at any time during treatment, or when used in combination with certain other drugs
- About your blood pressure. Cymbalta can increase your blood pressure. Your healthcare provider should check your blood pressure prior to and while taking Cymbalta
- If you experience headache, weakness, confusion, problems concentrating, memory problems, or feel unsteady while taking Cymbalta, which may be signs of low sodium levels
- If you develop problems with urine flow while taking Cymbalta

What should I avoid while taking Cymbalta?

- Cymbalta may cause sleepiness and dizziness. Until you know how Cymbalta affects you, you should not drive a car or operate hazardous machinery.

What are the most common side effects of Cymbalta?

- In clinical studies for approved indications (depression, generalized anxiety disorder, diabetic nerve pain, fibromyalgia, and chronic musculoskeletal pain, including chronic pain due to osteoarthritis pain and chronic low back pain), the most common side effect was nausea.
- Other common side effects included dry mouth, sleepiness, fatigue, constipation, dizziness, decreased appetite, and increased sweating.

This is not a complete list of side effects. See Boxed Warning, "Who should NOT take Cymbalta?" and "What should I talk to my healthcare provider about?" See full prescribing information at www.cymbalta.com. Talk to your healthcare provider if you have questions or develop any side effects. **You are encouraged to report negative side effects of prescription drugs to the FDA. Visit www.fda.gov/medwatch, or call 1-800-FDA-1088.**

What should I do if I think I have taken an overdose of Cymbalta?

If you have taken more Cymbalta than has been prescribed for you, contact your healthcare provider, a hospital emergency department, or the nearest poison control center immediately.

How should I take Cymbalta?

- Take Cymbalta exactly as directed by your healthcare provider.
- Cymbalta should be taken by mouth. Do not open, break, or chew the capsule; it must be swallowed whole.
- Cymbalta can be taken with or without food.
- If you miss a dose, take it as soon as you remember. However, if it is time for your next dose, skip the missed dose and take only your regularly scheduled dose. Do not take more than the daily amount of Cymbalta that has been prescribed for you.
- Remember to refill your prescription before you run out of Cymbalta.
- Talk with your healthcare provider before stopping Cymbalta or changing your dose.

General advice about Cymbalta

- Store Cymbalta at room temperature and out of the reach of children.
- Medicines are sometimes prescribed for purposes other than the ones listed. This medication has been prescribed for your particular condition. Do not use it for another condition or give this drug to anyone else.
- If you have any questions or concerns, want to report any problems with the use of Cymbalta, or want more information, contact your healthcare provider or pharmacist.

Additional information can be found at www.cymbalta.com.

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ALFA ROMEO 4C CONCEPT

We hate to get our hopes up, but the 4C will go into production by 2014, and there's a strong chance that it'll come to the United States. Its specs are as delicious as its skin: a turbocharged four-cylinder engine and a twin-clutch gearbox mounted behind the seats, rear-wheel drive and an aluminum chassis. The weight target is around 2000 pounds. Still, don't expect this beauty to be affordable.



INFINITI ETHEREA

The line between hatchbacks and sedans is blurring—witness the BMW 5 Series GT—and soon Infiniti will have its own segment-busting car. Due to arrive in Europe first, the Etherea drives the front wheels with a gas–electric hybrid powertrain. When it does reach production, the car won't have the rear-hinged rear doors. However, several design elements, such as the headlights and grille, will remain.

MORGAN 3 WHEELER

There hasn't been a Morgan trike since 1953, but that's about to change. The new 3 Wheeler tips the scales at just 1100 pounds and uses a 115-hp Harley-Davidson V-twin—the first Morgans were also powered by motorcycle engines in 1911—to drive a Mazda five-speed manual. It should scoot to 60 mph in a scant 4.5 seconds and offer the ethereal cornering capabilities the marque is known for.





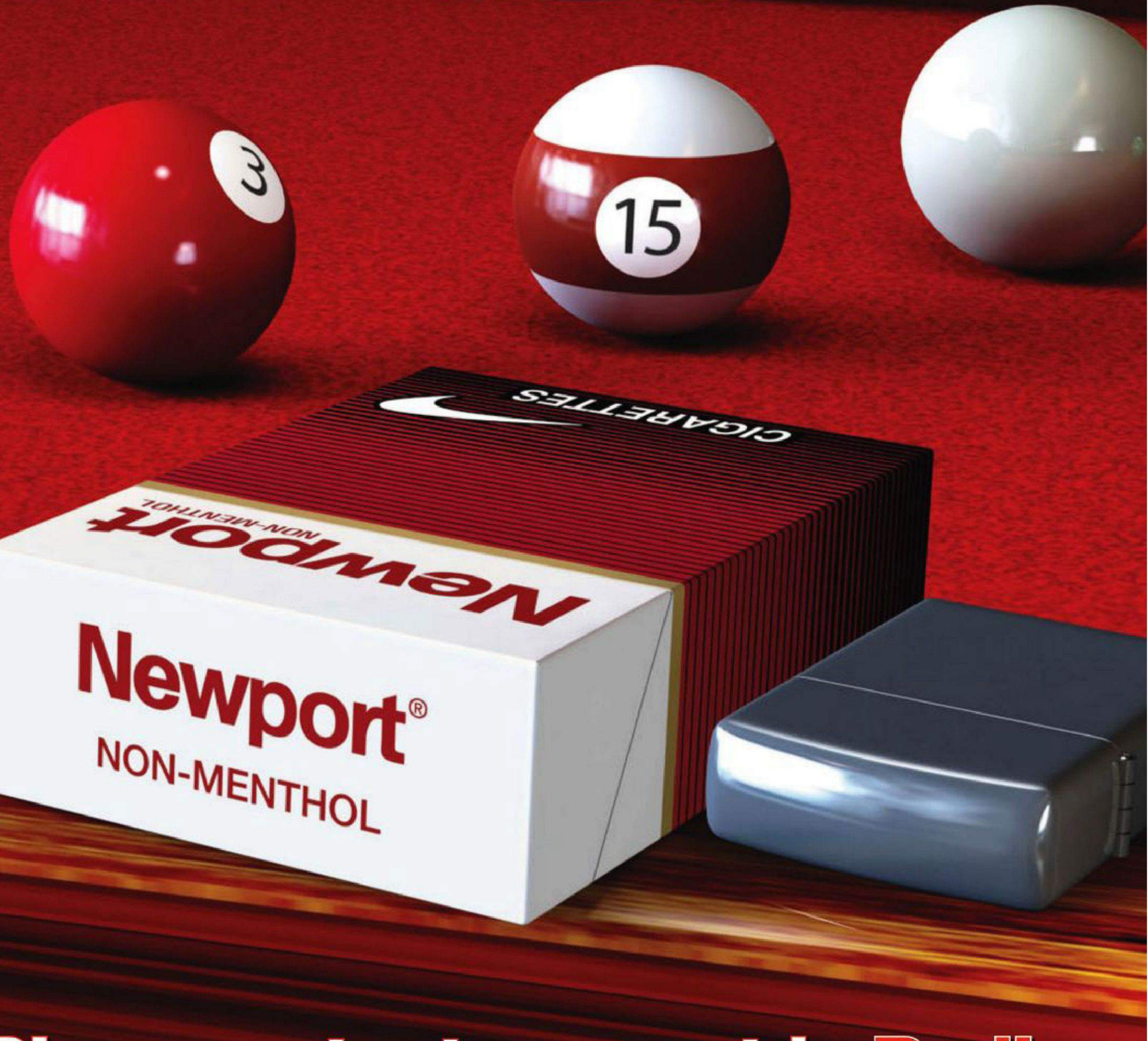
SUBARU SPORTS CONCEPT

Subaru and Toyota are jointly developing a moderately priced two-plus-two sports coupe. We've seen Toyota's version, the FT-86. But all we have so far for the Subaru are mechanical details. Coming about a year from now, both cars will use the Impreza's 150-hp flat-four engine, manual transmission and rear-wheel drive. If the car meets the under-3000-pound weight target, it could be an energetic sportster.

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Teaching Teen Drivers

Parents who want to maximize their kids' safety behind the wheel need to do more than shuttle their offspring to state-sanctioned driver's ed programs. For about the cost of a year's worth of dance or piano lessons, they can get trained in advanced skills. *BY REX ROY*



Parents can be quick to pay for music lessons or sports leagues for their children, but there's one critical area that is often overlooked—driver training. And often, top-flight instruction that goes beyond teaching traffic signs and delves into car control costs less than a week at sleep-away camp.

According to the Centers for Disease Control, teens crash at four times the rate of older drivers, and car crashes are the leading cause of teen mortality. Some programs have helped reduce the risk—graduated licenses that keep adolescents off the road late at night, for example—but our nation's behind-the-wheel instruction is lacking.

Currently, individual states regulate driver's ed. Requirements vary. Usually, these programs rely on classroom instruction to teach critical car-control maneuvers. Yes, all of us have been told to "steer into the skid." But without actually experiencing how turning the steering wheel in the same direction that the back end is fishtailing can arrest the slide, how meaningful is that tip?

At best, the teaching materials provide only the most basic information: Don't drink and drive, fasten safety belts, etc. At worst, the information is inaccurate or out-of-date. For example, Michigan teens are taught to hold the steering wheel at the 8 and 4 o'clock position, to protect the driver's wrists in the event of an airbag deployment.

But pros know better. According to Ford's driving safety guru, Kevin Markham, "hands go at 9 and 3, a position that allows for quick and accurate emergency responses from the muscles in wrists and arms." As far as wrist safety, "the 9-and-3 position keeps hands and arms away from a deploying airbag," Markham says.

Many countries require more rigorous training than the U.S. German drivers must complete expensive private instruction (for approximately $2500), and the U.K. offers a challenging advanced driving curriculum that nets drivers reduced insurance premiums. Finland has arguably the best program: In addition to 20 classroom hours on vehicle dynamics (why cars handle the way they do), students receive 30 hours of in-car instruction. And that includes skid-control sessions on a closed course.

No U.S. state requires the training equivalent of what's found in those countries. But some Americans do get good training—cops, for instance. "Our police cadets spend a minimum of 16 to 24 hours behind the wheel practicing

The skid-control car uses hydraulic rams and caster wheels mounted on outriggers to simulate vehicle slides. From inside this fantastic teaching tool, the instructor can make the car fishtail or plow so the student can safely practice recovery techniques.

ILLUSTRATION BY **PATSWERK**

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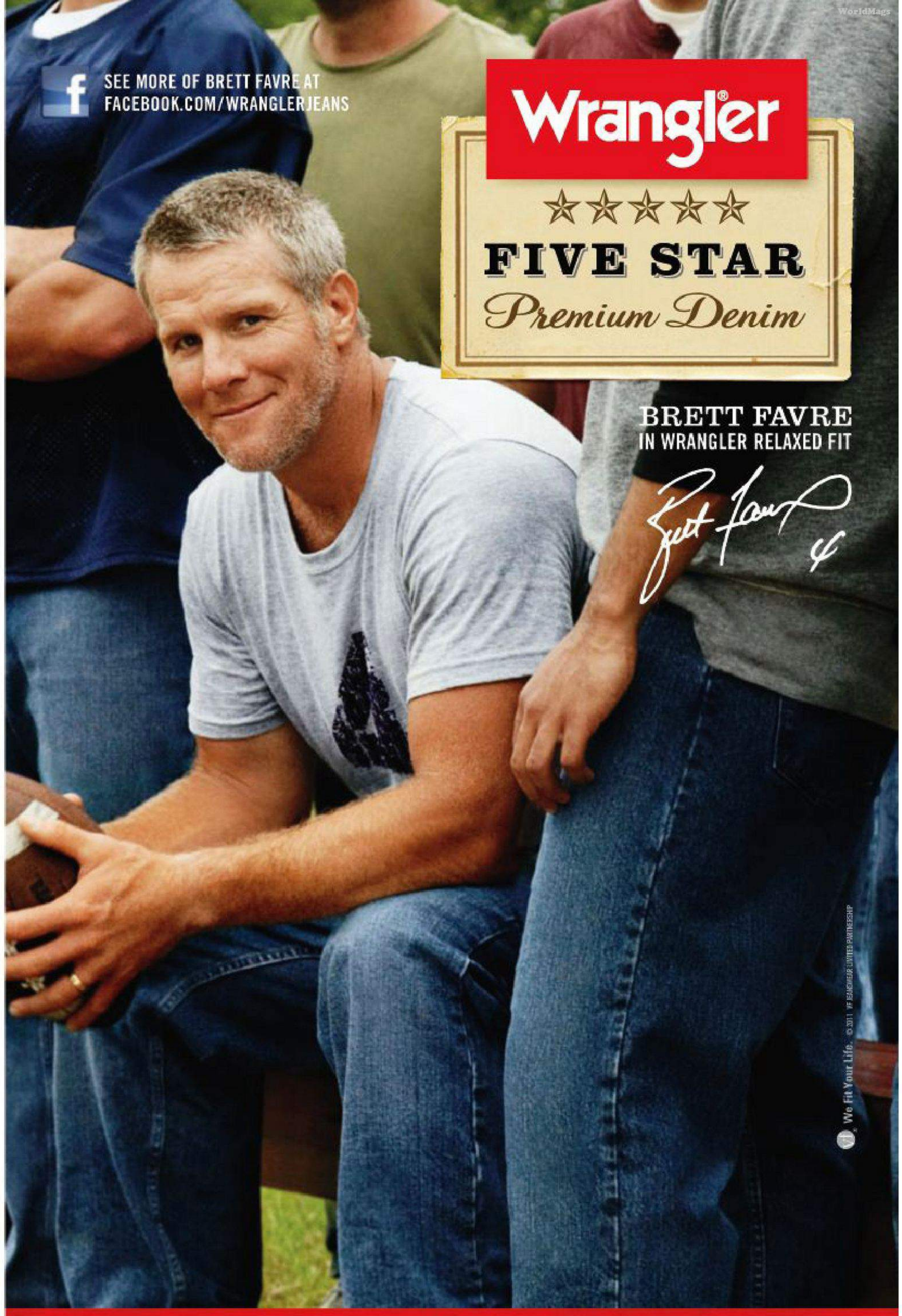
the vehicle skills we believe all emergency responders should have," says Charles Craft, the director of the Macomb Regional Police Academy in Michigan. The academy employs many of the same tools used at racing schools, including a skid car, which is a vehicle equipped with hydraulically actuated outriggers that can induce fishtailing—what's known as oversteer in racing circles—with the press of a button. "I think it's incumbent on parents to do more to educate their teen drivers," Craft says, "and while they're at it, parents should learn more about driving themselves."

American parents don't have access to police trainers, but they can procure excellent driving instruction for their kids. A number of high-performance driving schools offer courses for beginning drivers. For example, the Bob Bondurant School in Phoenix uses a skidpad area—basically a large paved field—and a skid car to allow drivers to experience slides and practice recovery techniques. Courses range from half-day sessions ($495) to comprehensive three-day experiences ($3095).

Can't make it to Arizona? The Skip Barber Racing School operates at 12 tracks across the country and trains teens using a one-day course ($999) that emphasizes skid control, vehicle dynamics and street awareness. In Ohio, the Mid-Ohio School runs an AAA-approved one-day defensive-driving course for teens ($375). Graduates are eligible for an insurance discount through Westfield Insurance.

Dozens of other advanced driving programs are offered across the country. Choose one that maximizes wheel time and enables students to explore a vehicle's at-the-limit braking and handling performance. As in sports, muscle memory matters. Longer courses provide more practice sessions for emergency evasive maneuvers; this repetition is critical to long-lasting training. **PM**

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2011 Jeep Grand Cherokee Overland

FIRST report

Having named the Grand Cherokee one of 2011's 10 best cars and generally applauded its character, we decided on an extended test to see if the shine would dull with familiarity. We picked the Overland edition, the highest trim level, because it includes air suspension and can be had with a V6 engine. The Overland stickers at $41,900—high, yes, but this is one richly detailed, feature-laden SUV. It can easily compete with other vehicles in this price range. In addition to items like heated and cooled seats and a heated wood steering wheel, there's also contrasting piping on the leather seats, and the console is covered with a handsome brushed-metal finish. But with all those luxuries, it's still a capable SUV. Beached on a snowdrift in a Midwestern blizzard, we pressed a button that quickly raised the chassis and provided enough ground clearance to get us back on our way. Yep, it's a Jeep. — *LARRY WEBSTER*

VITAL STATISTICS

Base price: $41,900
As tested: $45,480
Extra-cost options: Forward collision warning, blind-spot monitoring, radar cruise control, rear DVD entertainment center, power sunroof
Drivetrain: 3.6-liter V6, 5A, AWD
Engine performance: 290 hp, 260 lb-ft
EPA fuel economy: 16 city/22 highway

PHOTOGRAPH BY **MICHAEL NEMETH**

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Mazda2 Touring

SECOND report

This scrappy hatchback continues to get high marks. True, its acceleration is mediocre at best, and at higher speeds, the engine has the sound of a window fan on full blast—but behind the wheel, you feel like one of those diminutive athletes whose deft moves make up for his size. On curvy roads, it's almost zippy. The back seat claims to accommodate three. However, those folks had better be very thin and very compatible. It did carry two young boys on a trip to the Berkshire Hills in Massachusetts, and the cargo space held enough clothing, gear and footwear to permit a couple of days' hiking in uncertain weather. Also, there's something refreshing about driving a brand-new car with dials and knobs instead of all-digital controls. This car is far from perfect. It bounces around a bit in high winds. Still, considering the price tag and the stellar mileage, combined with the surprising fun factor, those faults don't seem like deal breakers. — *MICHAEL S. CAIN*

DRIVERS NOTEBOOK

- The gas and brake pedals are close together. It's a placement appreciated by enthusiasts who like to blip the throttle while braking and downshifting (although ours has an automatic gearbox), but commuters may find it annoying.
- The rear seatbelt latches are recessed deep in the seat cushions, making it tough for small kids to fasten themselves.

DATA SO FAR

As tested: $17,275
Previous reports: See 03/11
Miles driven: 6613
Miles since last report: 2031
Fuel economy: Average—30.3 mpg Worst—24.8 mpg Best—34.7 mpg
Maintenance/repair since last report: $0

Hyundai Sonata SE

THIRD report



The Hyundai Sonata almost seems to exist to thumb its front fender at cars like the Toyota Camry—practical, reliable, but yawningly boring midsize sedans. The sheet metal has sharp, windswept lines that look like a pair of knife swipes tracing the flanks, while the driving experience dispels any notion that an everyday car has to feel like an appliance. Our SE model is always in high demand among the staff, both for its engaging demeanor and its surprisingly roomy cabin—in just 10 months, it's racked up 14,800 trouble-free miles. The nonturbocharged 2.4-liter four-cylinder (Hyundai offers a turbo version but no V6 in the Sonata) delivers plenty of power—still, some drivers reported a high-rpm whine that probably wouldn't be present with a V6. The smaller engine has yielded good fuel economy, though—the Sonata is averaging 27.9 mpg and regularly gets above 30. Inside, the Sonata's design is elegant and straightforward, with nice touches like a leather-wrapped steering wheel and shifter that belie the $25,330 price. — *GLENN DERENE*

DRIVERS NOTEBOOK

- A few passengers have complained that the seats are stiff.
- Even onlookers appreciate the Sonata's design: Among other unsolicited positive remarks, we got a "nice car" comment in Queens, N.Y.

DATA SO FAR

As tested: $25,330
Previous reports: See 12/10, 03/11
Miles driven: 14,800
Miles since last report: 6692
Fuel economy: Average—27.9 mpg Worst—17.5 mpg Best—34.4 mpg
Maintenance/repair since last report: $0
Overall: $33

PHOTOGRAPHS BY CAL CRARY (MAZDA), ED KEATING (HYUNDAI)

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Diesel engines used to demand a certain patience in winter. Drivers had to wait for the engine's glow plugs to warm before starting the car, then ride in a freezing cabin while the motor took forever to heat up (the diesel's higher compression ratio means more of the combustion heat is used to drive the pistons rather than to warm the coolant). The X5's motor, however, fired immediately even on subzero mornings, and the standard electric heater made the cabin toasty in mere minutes. As we've said before, there's no penalty for the diesel's fuel economy, which proved remarkable—nearly 25 mpg over 16,000 miles. Furthermore, even when towing another car—the X5 can handle 6000 pounds—it still achieved 18 mpg. Factor in the X5's free maintenance and the fact that nothing went wrong during its stay, and we're left grumbling only about the $61,025 price. Most diesel engines are available in a handful of similarly spendy vehicles, a shame because a modern diesel is no more expensive than a hybrid—maybe less—and would work perfectly in moderately priced cars. —*L.W.*

BMW X5 xDrive35d

FINAL report

DRIVERS NOTEBOOK

- At parking-lot speeds, the steering requires some muscle.
- While the power tailgate is handy when your hands are full, it's slow to rise. Plus, engaging the button on the hatch requires a mighty squeeze.

END DATA

As tested: $61,025
Previous reports: See 08/10, 12/10, 03/11
Miles driven: 15,927
Miles since last report: 3506
Fuel economy: Average—24.9 mpg
Worst—16.2 mpg
Best—30.6 mpg
Maintenance/repair since last report: $0
Overall: $0



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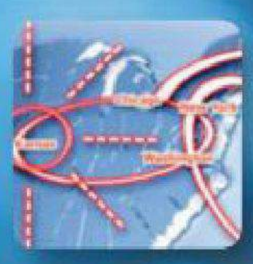
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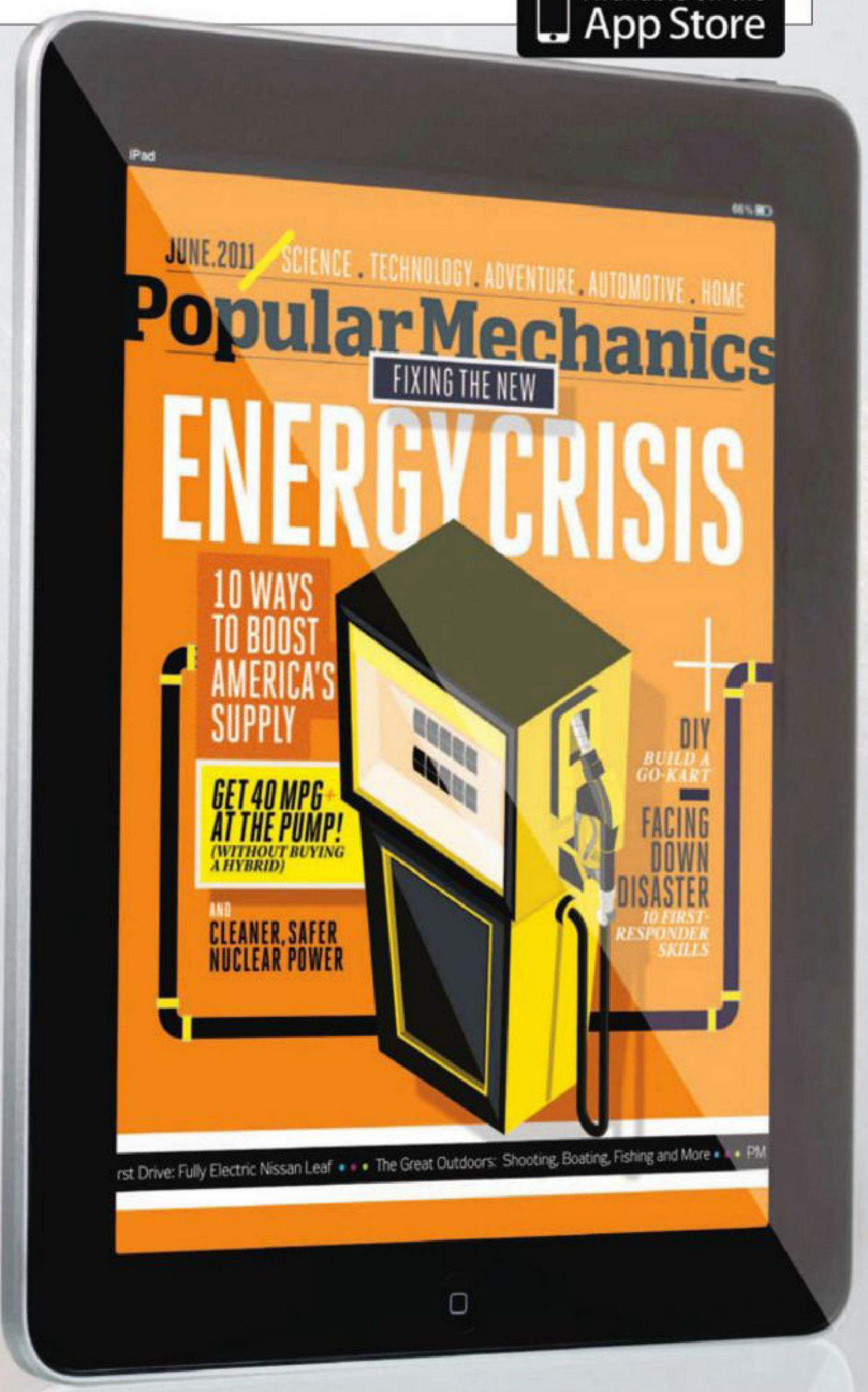
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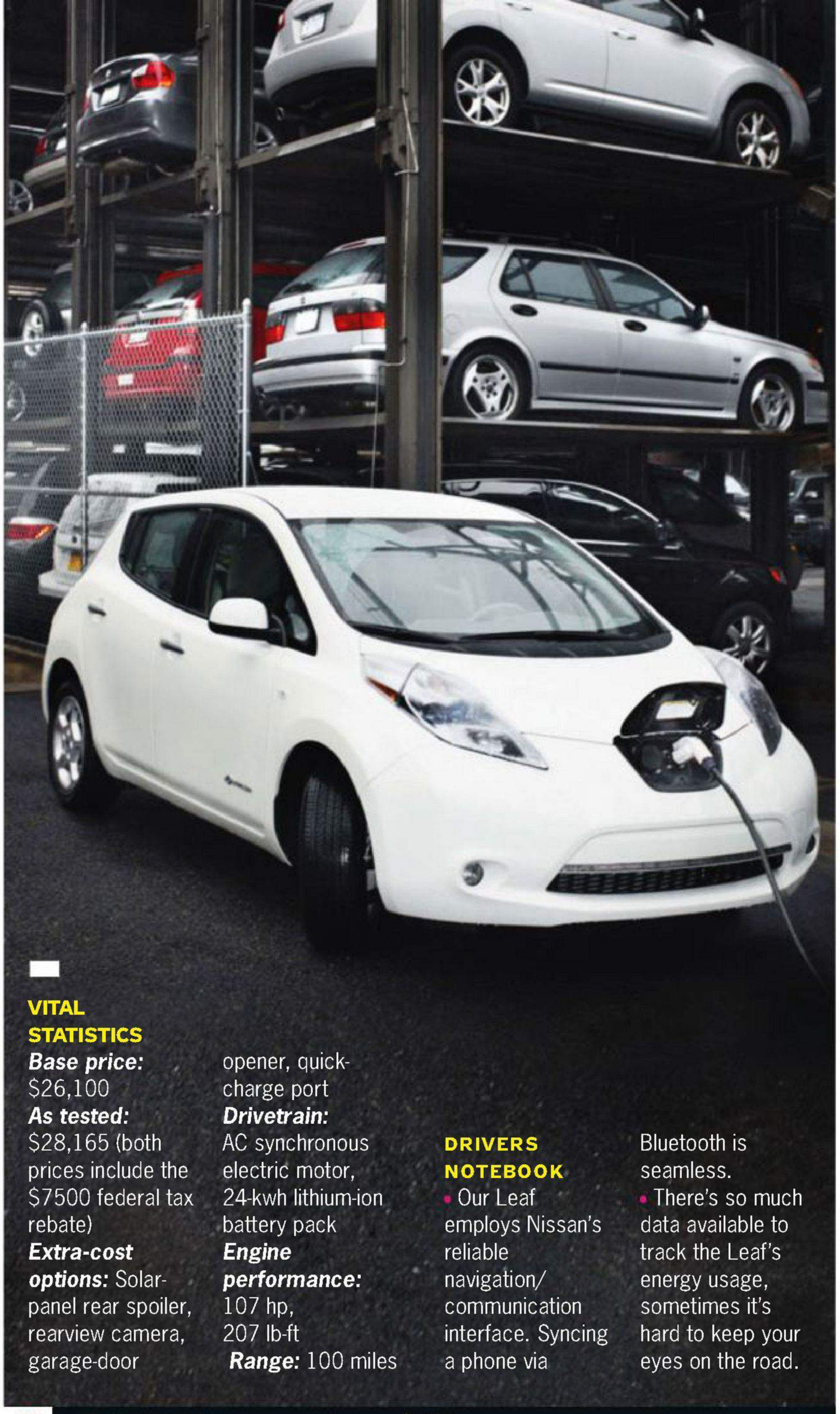
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VITAL STATISTICS

Base price: $26,100

As tested: $28,165 (both prices include the $7500 federal tax rebate)

Extra-cost options: Solar-panel rear spoiler, rearview camera, garage-door opener, quick-charge port

Drivetrain: AC synchronous electric motor, 24-kwh lithium-ion battery pack

Engine performance: 107 hp, 207 lb-ft

Range: 100 miles

DRIVERS NOTEBOOK

- Our Leaf employs Nissan's reliable navigation/communication interface. Syncing a phone via Bluetooth is seamless.
- There's so much data available to track the Leaf's energy usage, sometimes it's hard to keep your eyes on the road.

2011 Nissan Leaf SL

FIRST REPORT

The line between our cars and gadgets is collapsing fast. After three weeks with the Leaf, we're getting used to plugging in our vehicle just like our cellphones and iPads. Nissan strongly recommends that Leaf owners install a 240-volt charging station—it costs about $2000, including installation—to reduce charge time to about 8 hours. We installed the charger at PM's home, the Hearst Tower, which is now the first office building in New York City with the device. But the Leaf also comes with a cable that can plug into any 120-volt outlet. That's the mode PM editors use at home, though a full charge takes about 20 hours. Even so, with my 40-mile-round-trip commute, I found I could easily make it through the week without having to charge up at work. So, how does it drive? Pretty zippy, actually. Putting the pedal down at any speed produces a satisfying surge of torque. Of course, in an EV you tend to watch the range readout more than the speedometer, and even brief spurts of spirited driving—and use of the heater—take their toll on how far you can travel. Still, keeping obsessive track of energy consumption is part of the nerdy pleasure of driving this car. — *JIM MEIGS*

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As the space shuttle retires this summer, editor-in-chief Jim Meigs traces its bold accomplishments—and failures.

Was the Shuttle Worth It?

> BY JIM MEIGS

FIRST, SOME NUMBERS: When the program retires this summer, the fleet of five space shuttles will have flown 135 missions, made more than 20,000 orbits of the Earth, carried 363 people (some multiple times) and spent a total of more than 1300 days aloft. At peak thrust, the shuttle's engines burn 660,000 pounds of solid fuel and 45,000 gallons of liquid hydrogen every minute, accelerating the massive craft from 0 to 17,500 mph—and into orbit—in 8.5 minutes. The shuttle's longest mission lasted more than 17 days. Its shortest was, sadly, also its best-known: the doomed 1-minute, 13-second flight of the *Challenger* in 1986. Between the *Challenger* disaster and the loss of *Columbia* in 2003, the shuttle program has cost the lives of 14 astronauts.

For most Americans who, like me, believe human spaceflight is vital to our future, the shuttle remains a flying contradiction. On the one hand, it is an elegant and ambitious feat of engineering, able to carry large crews and big cargos, launch and retrieve satellites, and then land on a runway when it returns to Earth. Yet the shuttle is also an ungainly and impossibly delicate piece of hardware. (One launch was delayed because of damage from woodpeckers.) Conceived as a practical, affordable workhorse, it turned out to be unreliable and, with total costs of well over $1 billion per launch, wickedly expensive. And, of course, dangerous, with an overall failure rate of one per 67 missions.

As NASA prepares for the shuttle's expected final mission, to launch this month, we need to ask: Can we do better next time? The fact that NASA is ending the shuttle program before fully developing the next generation of space vehicle represents an egregious failure in planning. But it also presents an opportunity. What can we learn from the shuttle that will help the United States develop more agile and affordable space transportation?

The shuttle began as a daring and innovative concept. Although the Air Force had experimented with planes that could exit and re-enter the atmosphere, NASA, like the Soviet space agency, focused on rockets. Astronauts sat in capsules high atop multistage launch vehicles (like "Spam in a can," as Chuck Yeager and other aviators of the time sneered). All components except the capsules were expendable, that is, destroyed during flight. And the capsules' re-entry was ballistic—they fell, rather than flew, back to Earth. By the 1970s, when the shuttle was being built, expendable rockets routinely launched satellites and had carried men to the moon. Still, NASA hoped a reusable spacecraft could lower costs dramatically, making space travel almost routine. The

THE SPACE SHUTTLE WAS A NOBLE EXPERIMENT THAT WENT ON FAR TOO LONG.

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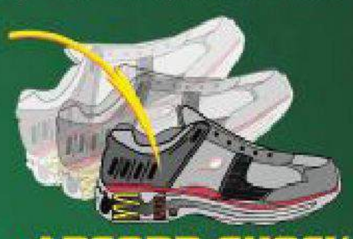
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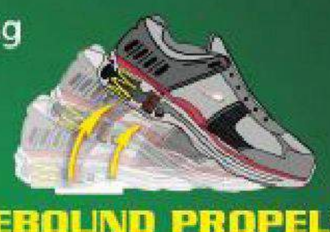
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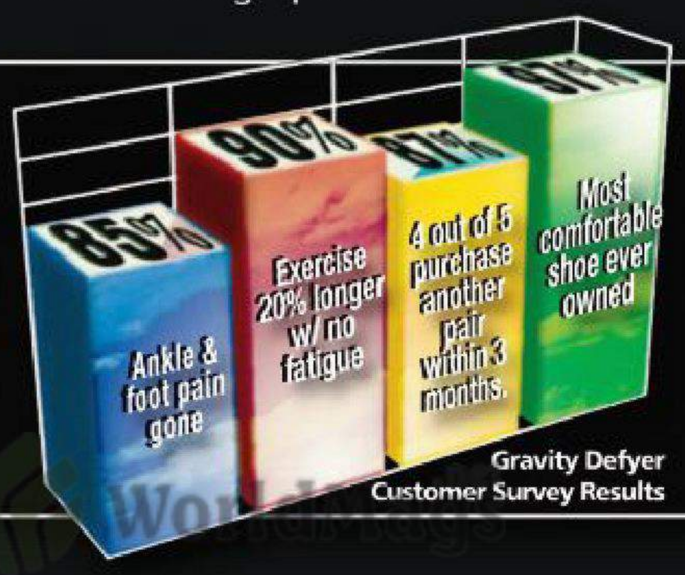
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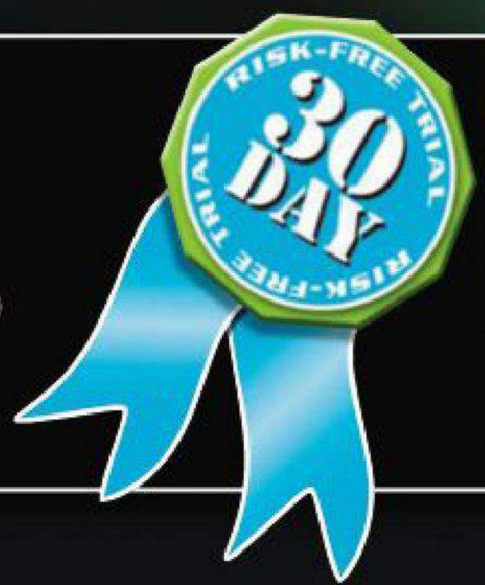
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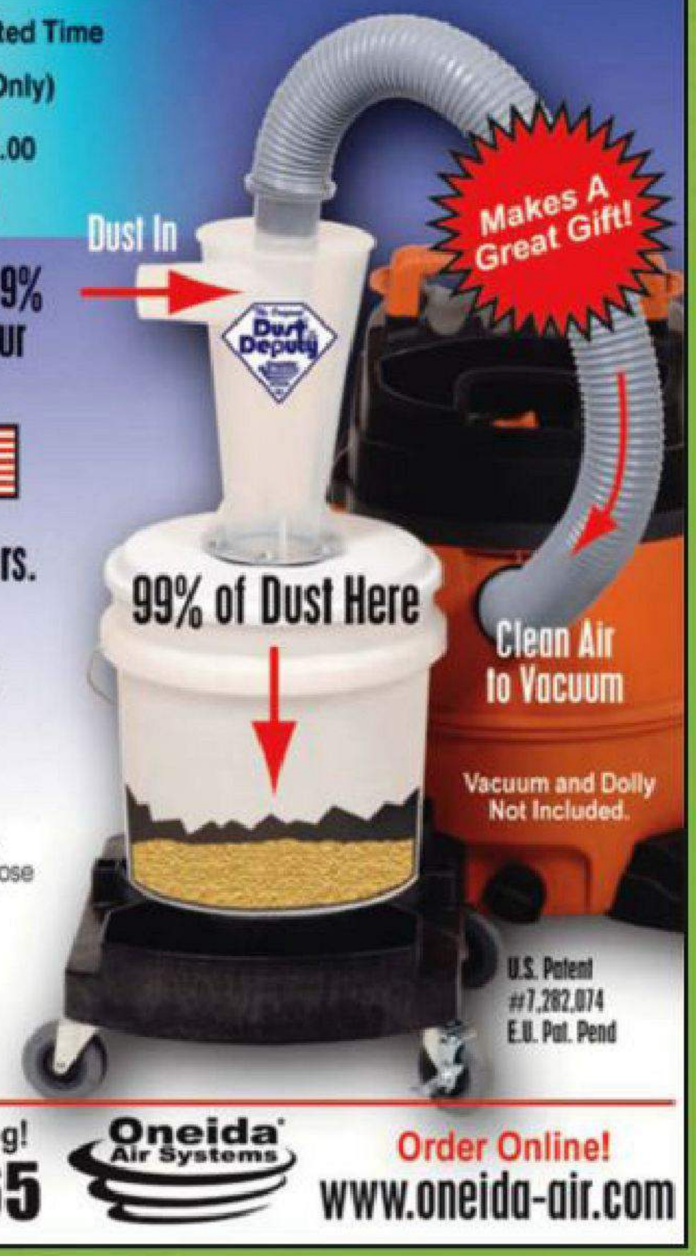
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agency envisioned launches occurring roughly once a week.

But alarms were raised early on. Space policy writer Gregg Easterbrook labeled the shuttle a "death trap" in 1981, before it ever flew, and argued that the program should be shut down. Then the 1986 explosion of the *Challenger* put the program into permanent go-slow status. By the early 1990s, it was clear that the shuttle would never become the practical workhorse of NASA's dreams.

So why didn't they just retire it? Perversely, the high cost of the program was one key to its long survival. Some 15,000 contractual employees and 2000 civil servants were needed to keep the shuttle running. Many of those contractors and workers were strategically distributed across a belt of politically potent states from Florida to California. And those states' congressional leaders—such as Texas senator Kay Bailey Hutchison—were dependable defenders of the shuttle. Ironically, a leaner, more affordable space vehicle probably would have garnered less support in Congress.

In the end, the shuttle's legacy encompasses both the best and the worst of NASA. The agency was courageous to launch the project. But later, NASA's inability to admit the shuttle's failures revealed a worrisome tendency toward bureaucratic inertia. If the United States is to be a space-faring nation, our space agency needs to be far more nimble.

On the route to innovation, entrepreneurs know that even good ideas usually have to be tweaked, modified and sometimes abandoned. "When something is attempted for the first time, there will be failures," shuttle commander Col. Eileen Collins recently told PM. "That is part of the flight test process." The program had many successes—large crews executed complex missions, including facilitating the building of the International Space Station and keeping the Hubble telescope in service. And even the shuttle's failures delivered valuable lessons, from the damage debris could cause to heat shields to the need for an effective escape system. Collins, who flew four missions (including the first after the loss of *Columbia*), says, "We learned so much about what to design in or out next time."

Right now, NASA seems to be pursuing a smart strategy: turning partly to private industry to build and launch new generations of spacecraft. In the early days of airmail, the U.S. Post Office flew using its own planes and pilots. But a 1925 law mandated that the Post Office simply set a rate it would pay private companies to carry the mail. Aviators like Charles Lindbergh and entrepreneurs like William Boeing seized the challenge, launching an era of aviation breakthroughs.

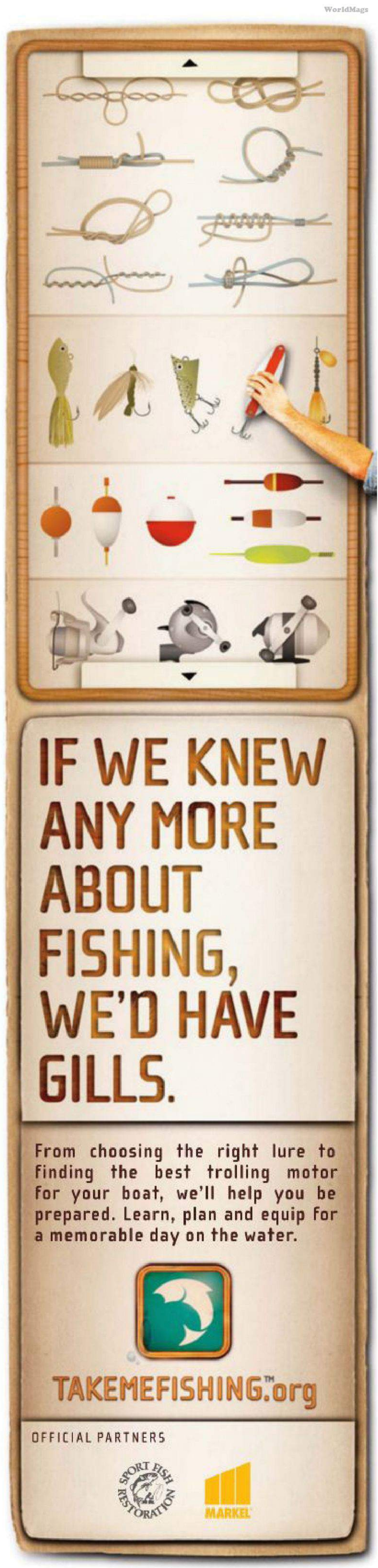
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Instead of specifying particular spacecraft designs, NASA needs to define its missions, then take bids from private contractors that can innovate quickly—and retire unsuccessful experiments just as fast. Today, private companies routinely launch satellites at competitive prices, while innovative outfits such as XCOR Aerospace, SpaceX, Orbital Sciences and Armadillo Aerospace are building new launch vehicles. And businesses are already competing to carry paying passengers into space. In the future, NASA may be just one client among many hiring their services.

As the shuttle prepares for its final flight, let's remember to salute the innovation of its design and the dedication of the astronauts who flew it. The shuttle was a bold experiment. But it kept flying far too long. We can do better next time. **PM**

Additional reporting by Alyson Sheppard.

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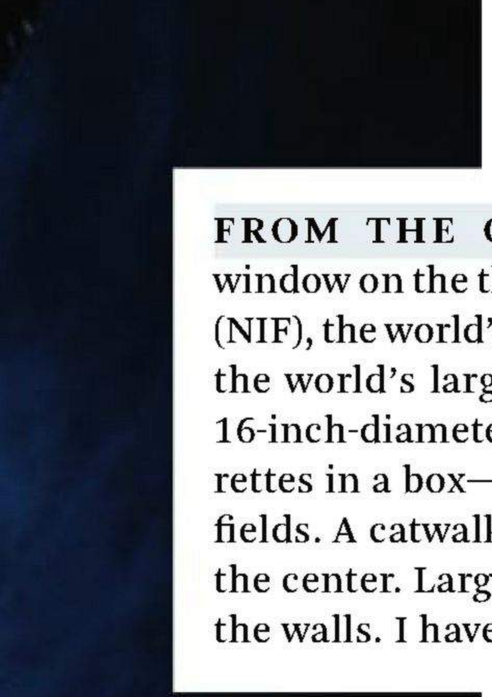
Technicians inspect the target chamber at the National Ignition Facility in Livermore, Calif. During a fusion reaction, lasers will heat a pea-size capsule of hydrogen fuel to more than 100 million degrees Celsius, fusing the atoms' nuclei and releasing energy.

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CHEAP, UNLIMITED ENERGY HAS BEEN JUST AROUND THE CORNER FOR DECADES. NOW, FUSION PROGRAMS RANGING FROM BILLION-DOLLAR GOVERNMENT FACILITIES TO SCRAPPY STARTUPS HAVE TAKEN THE FIRST TENTATIVE STEPS TOWARD GENERATING STAR POWER.

IS FUSION FINALLY FOR REAL?

BY ELIZABETH SVOBODA

FROM THE OTHER SIDE OF A WIDE GLASS window on the third story of the National Ignition Facility (NIF), the world's largest laser array looks an awful lot like the world's largest plumbing project. Row after row of 16-inch-diameter pipes are packed into a room like cigarettes in a box—only the box is the size of three football fields. A catwalk thick with miles of cable runs through the center. Large metal ducts snake overhead and along the walls. I have to take it on faith that the pipes, called beam tubes, don't contain water or gas, but 192 separate laser beams zipping back and forth. When the beams finally exit the room, their strength amplified more than a quadrillion times, they will converge on a pencil-eraser-size target in one short, powerful pulse. And in those 20-billionths of a second, I'm told, atoms of hydrogen will smash together with such force that they'll essentially create a star.

It sounds impressive—and certainly looks imposing—but society has been taking promises of fusion on faith for more than five decades. If fusion works as proponents claim, it could produce enough clean energy to power the world for hundreds and hundreds of years to come. One of the first hurdles is the tiniest component, the fuel: Hydrogen isotopes, such as deuterium and tritium, adamantly resist uniting, regardless of the amount of heat and steel and funding thrown into the effort.

But this past fall, physicists at NIF, based at Lawrence Livermore National Laboratory in California, made an important advance with their elaborate building

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and enormous laser: They fired 121 kilojoules of ultraviolet light into the $3.5 billion facility's target chamber, causing deuterium and tritium nuclei to fuse into helium atoms, releasing 300 trillion high-energy neutrons. Even though NIF and other labs have created fusion before, the achievement brings researchers a step closer to conquering the ultimate challenge: a fusion reaction that produces more energy than is required to start it.

Expensive megaprograms such as NIF aren't the only ventures making progress. At the other end of the funding spectrum, a number of innovative startups have also begun to yield promising results. After decades of frustratingly slow research, the emergence of real, practical fusion power may come down to a race between these entrepreneurial Davids and the government-run Goliaths.

Given the recent partial meltdown of reactors in Japan, finding public support for any form of nuclear energy might seem unlikely. Still, fusion has some important safety advantages over nuclear fission: To produce energy from fission, atoms such as uranium-235 are split into radioactive elements, some of which have extremely long half-lives. Nuclear fusion produces helium and neutrons, and no super-long-lived radioactive waste. Plus, fusion cannot cause runaway reactions because it requires a steady input of energy for the isotopes to fuse; any plant malfunction would cause near-immediate shutdown. Over the long term, fusion power might reduce pressure on fossil fuels such as oil and coal, while complementing clean but intermittent energy sources such as wind and solar.

To produce electricity, the heat generated during a fusion reaction could be harnessed to drive a steam turbine, just as in any power plant. The difference is that fusion doesn't rely on the trainloads of coal, shipments of uranium, oil and gas drilling rigs or elaborate pipelines that feed today's facilities. Deuterium is found in seawater. "See those two water jugs right there?" says Edward Moses, the director of NIF, pointing to a display in the facility's atrium. "Those would have the energy equivalent of a supertanker of oil."

AT THE MODEST HEADQUARTERS OF HELION ENERGY IN REDmond, Wash., the off-Broadway equivalent of the colossal NIF production is beginning to play out. The company is tucked away at the back of a nondescript suburban office park in a space not much bigger than a dentist's office; if you weren't specifically looking for Helion, you'd never come across it. A reception desk near the entrance has been repurposed into a workbench strewn with electronic components. Colored cables dangle overhead in free-form clusters, and workstations are propped up with cinder blocks. At one point, the researchers talk about a 10-tesla coil they're working on to amp up the strength of their reactor's magnetic field. "We built that coil," scientist George Votroubek says. "Have you showed her yet?"

"No," his colleague Chris Pihl replies casually, "it's on the front counter."

Helion is among a handful of fusion startups, such as Tri Alpha Energy in Foothill Ranch, Calif., and General Fusion in Vancouver, British Columbia, all striving for the same grand goal as their outsize government counterparts: remaking the global energy landscape by proving that fusion power is feasible. A few forward-looking venture-capital firms have provided funding to get them off the ground; Tri Alpha, for instance, has attracted more than $50 million from a variety of prominent firms, including Goldman Sachs and Vulcan Capital.

Helion's technology was developed for about $5 million by MSNW, a company owned by University of Washington research associate professor John Slough. To see a full-scale component of the reactor, which Slough calls a fusion engine, I meet him at an industrial building a few minutes' drive from Helion's headquarters and walk past a conference table to a room filled with giant metal parts.

Inside the 26-foot-long prototype, two plasmas—clouds of hot ionized gas containing hydrogen isotopes—hurtle toward each other. The clouds collide inside a burn chamber, merging into a single entity. An electromagnet surrounding the chamber squeezes the plasma tighter and tighter, creating the high temperature and pressure conditions needed for fusion—a milestone MSNW first passed in 2008. "The idea," says Slough, who has the white

"SEE THOSE TWO WATER JUGS RIGHT THERE?" THE DIRECTOR OF NIF SAYS. "THOSE WOULD HAVE THE ENERGY EQUIVALENT OF A SUPERTANKER OF OIL."

DIAGRAMS BY DOGO



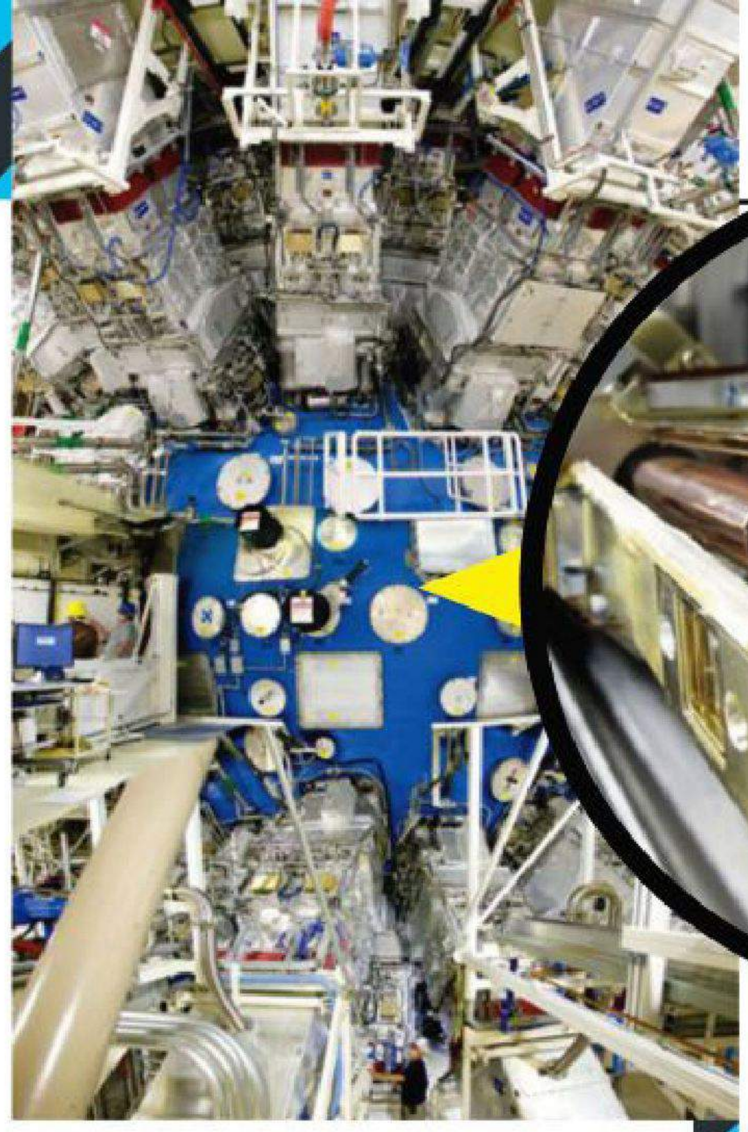
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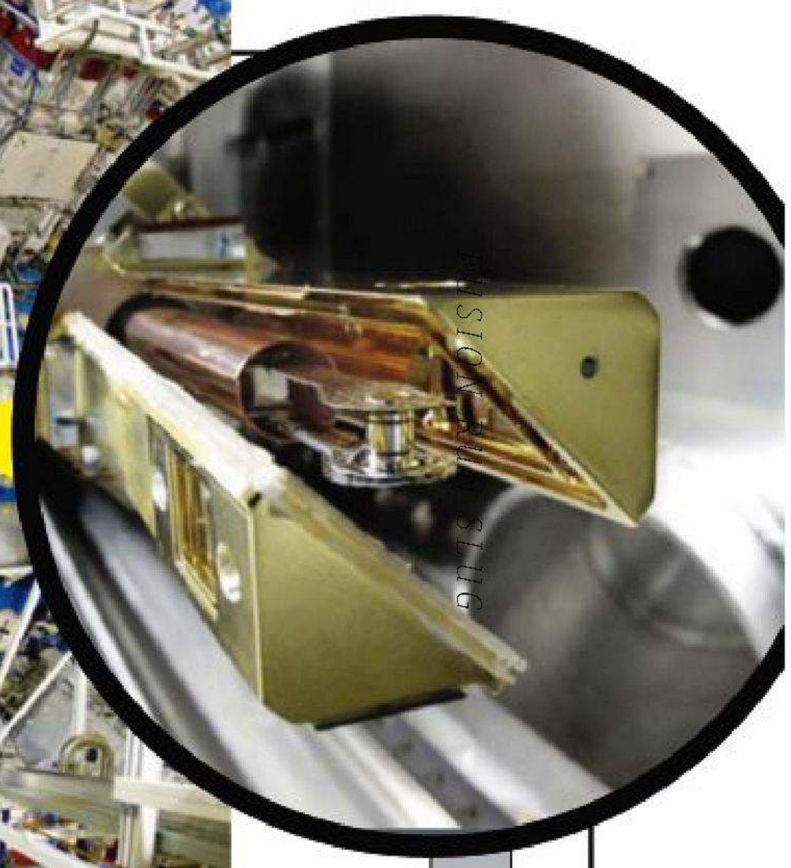
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FUSION FROM THE WORLD'S BIGGEST LASER



At the National Ignition Facility (NIF), "inertial confinement fusion" begins with a very small, weak laser pulse. This pulse is split into 48 beams and sent to preamplifiers, which increase the energy to a few joules. The laser is split further into 192 beams and injected into beamlines that enter two massive bays. The beams then pass through two systems of glass amplifiers, which increase their power to 20,000 joules. After leaving the main laser building, the parallel beams are rearranged into a spherical configuration by mirrors in 10-story-tall "switchyards." A final optics assembly converts the lasers' wavelength from infrared to ultraviolet, and a lens focuses them on a precise target in the center of a chamber.



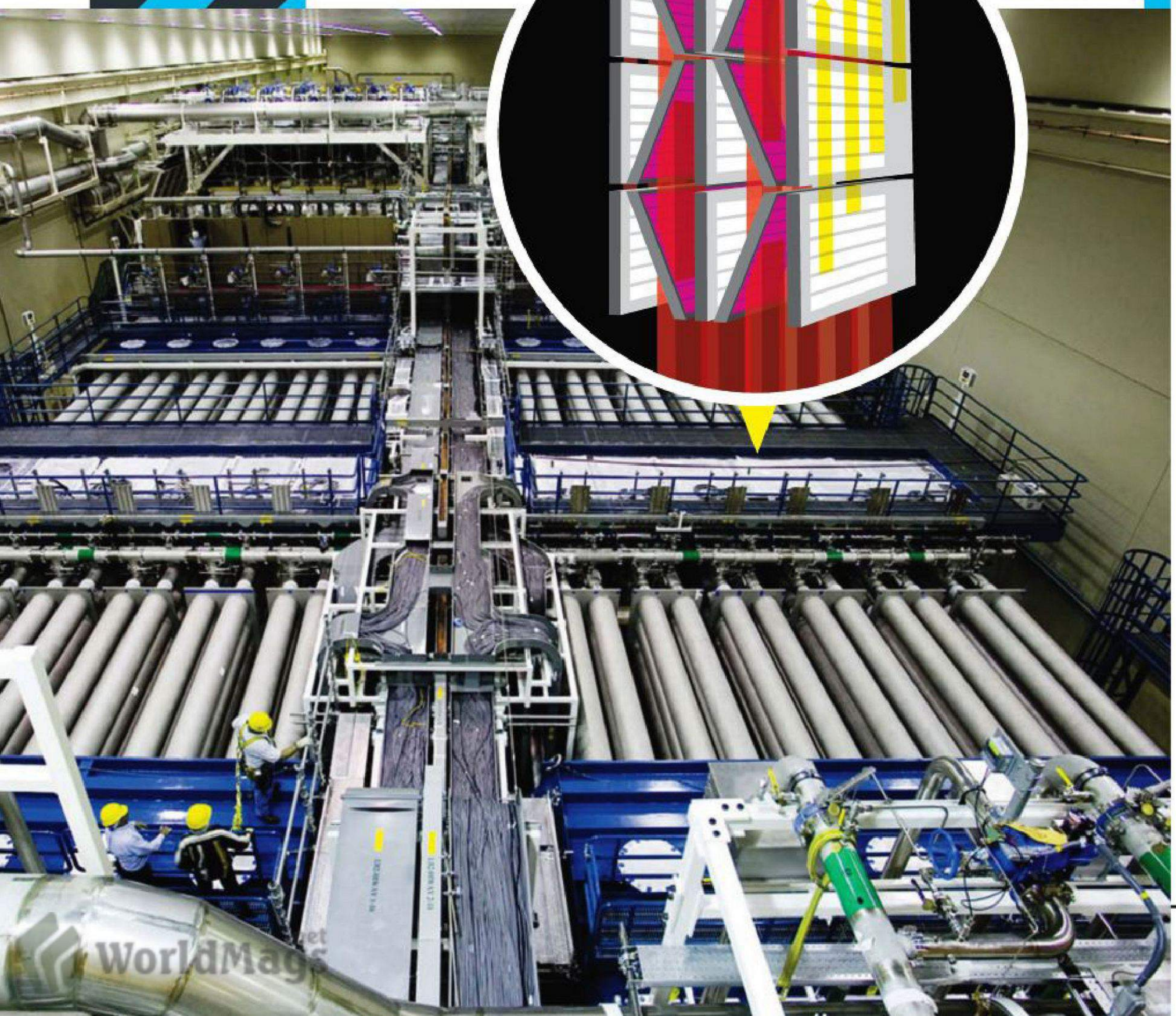


TARGET CHAMBER

NIF's target chamber (above) contains the fuel for fusion: a dime-size gold cylinder, called a hohlraum, encasing a beryllium-coated capsule with deuterium and tritium atoms. When lasers strike the hohlraum, their energy is converted to X-rays that burn away the capsule, compressing the fuel and forcing it to implode.

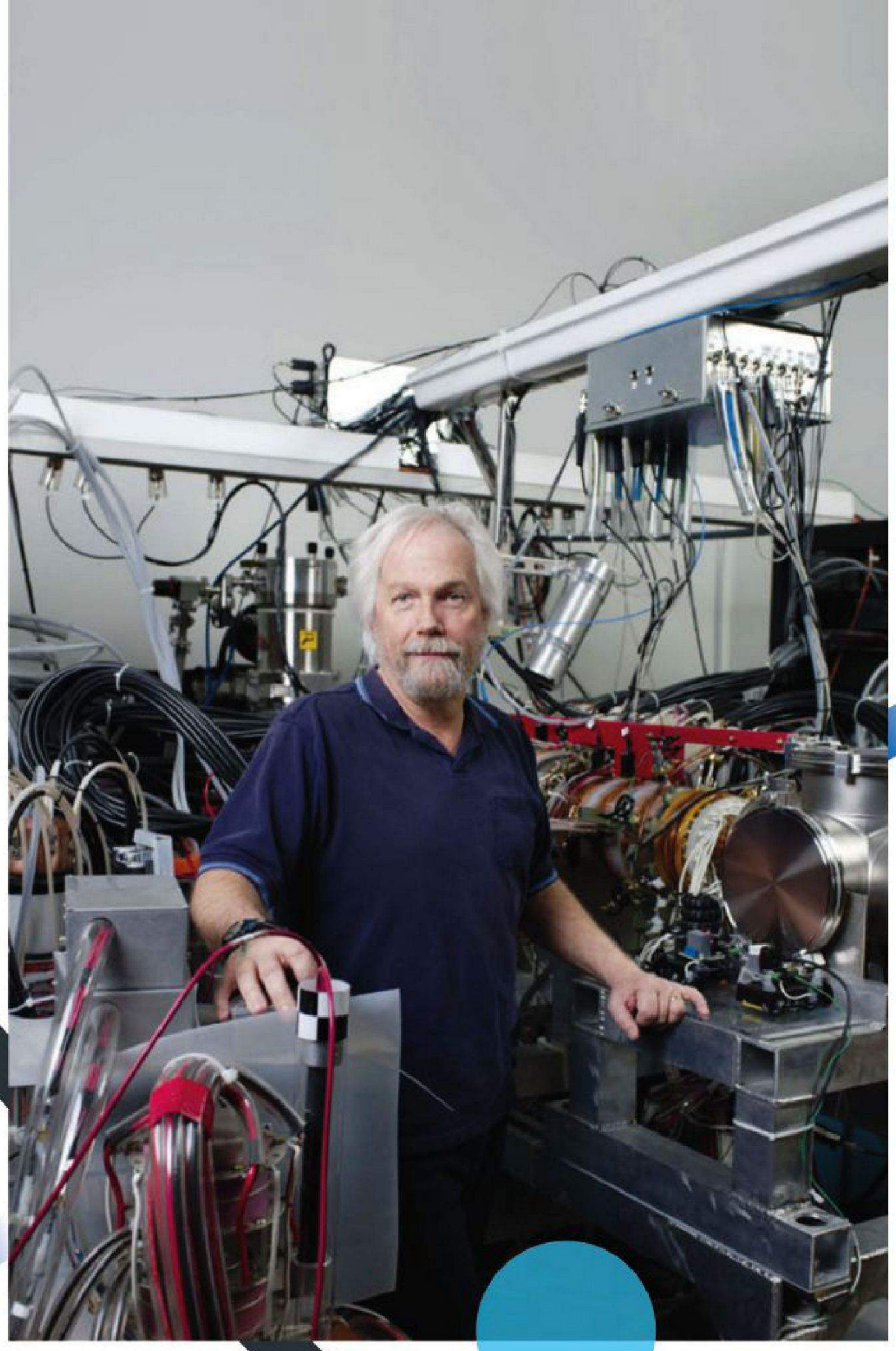
AMPLIFIERS

A system of amplifiers (shown in the laser bay, below) provides 99.99 percent of NIF's power. Vertical arrays of flash lamps excite neodymium atoms embedded in slabs of phosphate glass. As lasers pulse through the glass, they pick up that energy.



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Helion Energy cofounder John Slough in the Redmond, Wash., skunkworks. Slough says his reactor's simplicity and low cost give him a huge advantage in the fusion power race. "No one's gonna give you 10 or 20 billion dollars to experiment," he says.

hair and slightly disheveled appearance of a modern-day Einstein, "is to have the energy that comes out of the plasma exceed the energy that goes into it for a brief period of time."

Management Information Services senior energy adviser Robert Hirsch, a former director at the U.S. Atomic Energy Commission, argues that startup companies may have some surprising advantages. Forced by funding constraints to design systems that are as simple as possible, startups are likely to end up with clean, lean reactors instead of complex, monolithic ones, like NIF's, which have the potential to fail in dozens of different ways. "If you're going to build a successful fusion system, it's going to be inherently small," Hirsch says. With a scaled-back approach, "there is a good chance they could make something that works."

The team announces that they're about to show me exactly what Helion-style fusion looks like. "You might want hearing protection for this," the company's president, Philip Wallace, says, handing me a pair of industrial-strength earmuffs. His colleagues power up the device. After the countdown clock on someone's iPhone drains to zero, there's a burst that sounds like a bulb breaking and a flash of pink light so bright that I have to turn away for a second. Wallace turns to me triumphantly: "You just witnessed fusion."

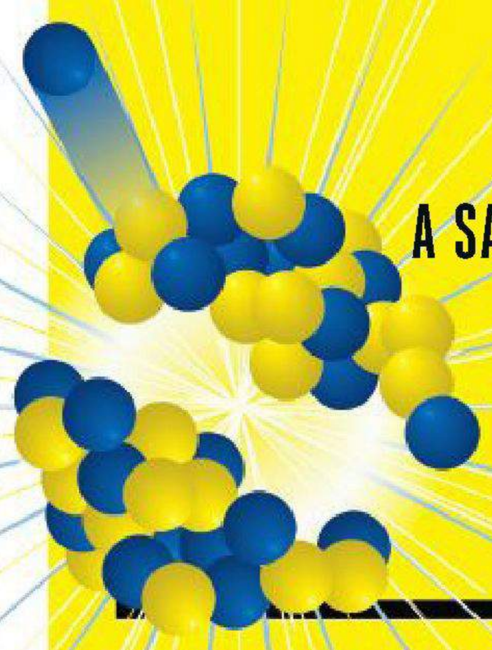
THE IDEA OF GENERATING power from fusion has captured scientists' imaginations ever since U.S. physicist Edward Teller developed the first fusion-based hydrogen bomb, which released hundreds of times more energy than a fission bomb, in 1952. (Hot-fusion-powered approaches to creating energy are completely different from discredited "cold fusion" experiments, in which a current is passed through an electrode in heavy water in an attempt to coax nuclei to combine.) But in early tests of fusion, plasma leaked out of the confinement zone inside reactors faster than scientists had predicted, scuttling fusion reactions before they could occur.

Fusion's prospects seemed to improve in the 1960s, when scientists in the Soviet Union tested a new type of fusion reactor called the tokamak. It featured a doughnut-shaped, electrically generated magnetic field that kept the plasma confined. Most international fusion research to date has followed the tokamak model; experimental tokamak reactors such as the United Kingdom's Joint European Torus (JET) and Japan's JT-60 have helped scientists understand how to confine and handle fusion plasmas. Leveraging this knowledge, 34 nations are collaborating to build the world's largest tokamak, called ITER, a demonstration project tentatively slated to start operation in France in 2019.

NIF scientists have taken a completely different approach. Instead of undertaking the delicate task of confining plasma inside a magnetic field, they aim to produce a controlled version of the fusion that takes place inside the sun or a hydrogen bomb, using lasers as the reaction's driver—a technique called inertial confinement fusion. NIF's Moses notes that many of the building blocks of the

PHOTOGRAPH BY **JOHN KEATLEY**

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A SAFER FUTURE FOR FISSION

A fusion economy, if it ever materializes, is at least a couple of decades away. In the wake of the recent disaster in Japan, the world needs near-term technologies capable of improving the safety of nuclear fission. Here are a few of the most promising possibilities, which could turn into important power sources in their own right.

MINI-REACTORS

Oregon-based NuScale Power's proposed 45-megawatt mini-reactors are the Lego bricks of the nuclear power world—self-contained reactor/containment structures that can be stacked together or separated as regional needs dictate. "You install a module as the power demand increases—it's a plug-and-play sort of model," says Jose Reyes, chief technology officer at NuScale. Because the entire reactor assembly sits in a concrete bunker underground, these mini-reactors might prove safer for use in areas that have a history of seismic activity.

FISSION BATTERIES

Could compact nuclear plants become go-to power sources for off-grid homes and businesses? That's the vision of Hyperion Power Generation, based in Santa Fe, N.M. About the size of an outdoor hot tub, Hyperion's 25-megawatt fission batteries could potentially be installed just about anywhere; Hyperion plans to refuel them once every eight to 10 years. Because liquid metal, not pressurized water, cools Hyperion's reactors, radioactive material would not likely spew into the air in case of an accident, says Deborah Blackwell, Hyperion's vice president for public policy: "The fuel would just sit in the bottom of the reactor and become a big paperweight, containing the radioactivity."

THORIUM

This radioactive metal is three to four times more common than uranium fuel, and unlike uranium, it doesn't generate weapons-usable nuclear material after it's burned in a reactor. Thorium could potentially be dissolved in a mixture of liquid salts and used to power so-called molten-salt fission reactors. These highly meltdown-resistant reactors aren't yet ready for widespread rollout, but some scientists project they will be able to reburn thorium's long-lived radioactive waste products as well—yielding much smaller waste piles than traditional light-water reactors.

project's massive laser array have already been used successfully in other industrial settings: Laser diodes similar to NIF's have enabled fiberoptic data transmission in the telecommunications industry for years. "It's a good place to be when you're riding the wave of other people's work," he says.

With its pulsed magnetic field design, the Helion team claims it has found the elusive sweet spot in the fusion landscape: a reliable, cheap reactor that doesn't require fine-tuned optics or complicated plasma confinement. In Helion's reactor, electric currents flowing inside the plasma reverse the direction of a magnetic field that's applied from the outside; the new, closed field that results effectively confines the plasma. "Compared to the tokamak and NIF, Helion's reactor is relatively compact and low-cost," says Richard Milroy, a physicist at the University of Washington who isn't affiliated with Helion. "Utilities don't need to invest billions for the first test reactor to see if things will work out." Plus, he says, the plasma-formation area is separate from the burn chamber in Helion's reactor, so its expensive components may last longer.

Still, all of these experimental fusion approaches face a host of scientific and practical unknowns. The massive numbers of neutrons generated during fusion may damage components of a tokamak over time, and the plasma inside can also become unstable, impeding the reaction. And even though NIF has managed to achieve partial fusion by firing individual rounds into its target chamber, similar lasers would likely need to fire 10 to 15 times every second in LIFE, the demonstration power plant Lawrence Livermore is designing for the early 2020s. That kind of consistent firing would require a laser driver with a high repetition rate, which has yet to be developed and tested.

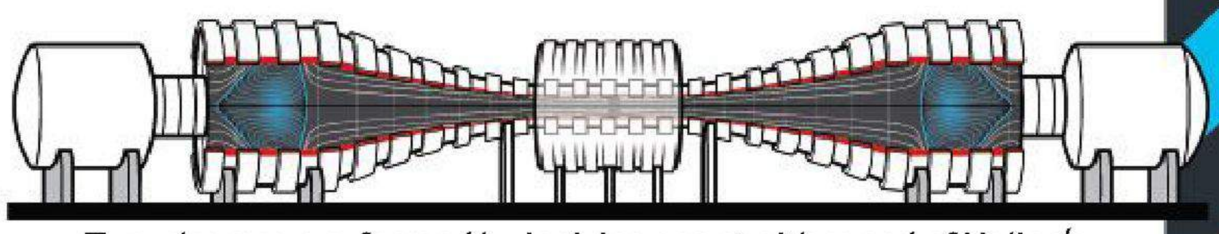
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FUSION FROM PLASMAS COLLIDING IN A LIVING-ROOM-SIZE ENGINE SURROUNDED BY MAGNETS

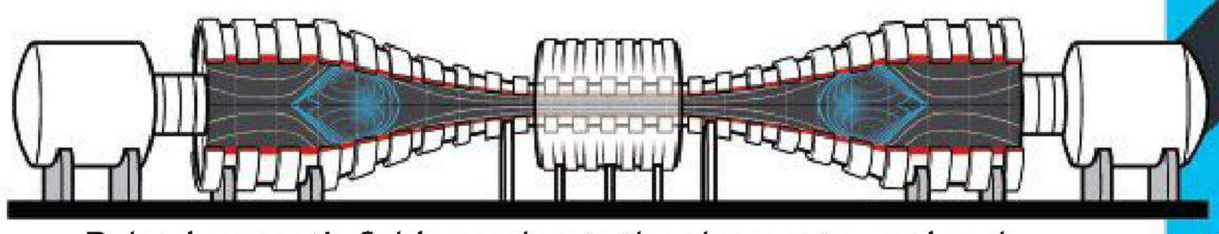
The fusion reactor licensed by startup Helion Energy features a field-reversed configuration, in which a closed magnetic field created by electric currents inside plasma—hot ionized gas containing hydrogen atoms—keeps the plasma confined. The magnetic field also captures high-energy helium ions created during the fusion reaction, replenishing some of the energy used to start the reaction.

STAGE 1



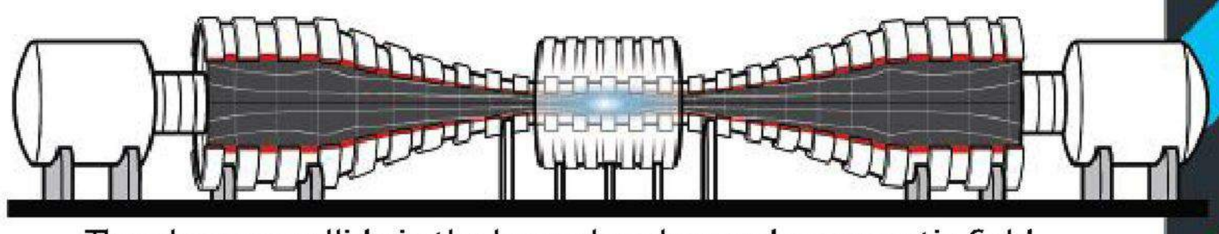
Two plasmas are formed by ionizing gas at either end of Helion's one-third-scale prototype fusion engine (see photo below).

STAGE 2

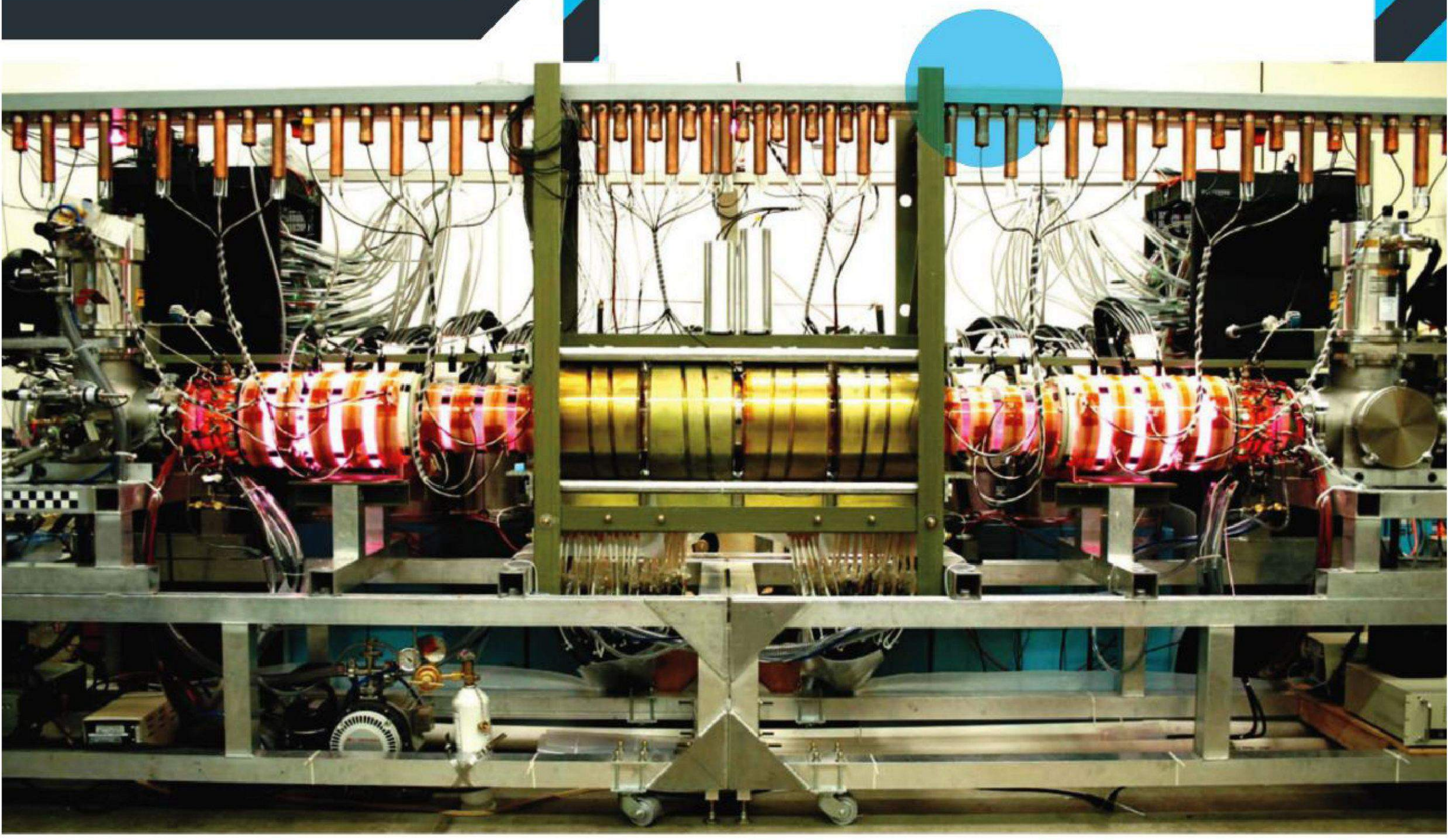


Pulsed magnetic fields accelerate the plasmas toward each other at 1 million miles per hour.

STAGE 3



The plasmas collide in the burn chamber and a magnetic field compresses them further, raising temperatures to 25 million Celsius. Hydrogen nuclei in the plasma fuse, releasing energy.



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While Helion's reactor is much simpler than those of ITER or NIF, it's also not yet powerful enough to be useful to a utility. Slough says his team will need to increase the size of the reactor's magnetic confinement field and boost the acceleration rate so that the plasmas will be traveling about twice as fast by the time they crash into each other. Those refinements will require at least $15 million to $20 million in development costs, money Helion does not currently have. Even if the funds materialize, there's no guarantee the reactor will work as projected when scaled up, or function consistently over long periods of time.

Wallace has traveled all over the U.S. and Europe, trying to secure money for this next phase, but, so far, firms haven't seemed interested in bankrolling a company that may take a quarter-century to start making reliable power. "Nobody's said they don't believe our science, but it's a struggle," he says. "We believe we're a long way ahead, but we're also not close to the finishing line."

FOCUSING ON FUSION'S FEASIBILITY SIDESTEPS A QUESTION that's perhaps more crucial: whether we should be pursuing fusion energy at all. For every optimist, there's at least one expert who believes fusion will never become a commercial reality. "One aspect that gets underestimated is the great challenge of converting the energy of fusion into useful electricity," says David LeBlanc, a physicist at Canada's Carleton University. Even when fusion reactions are successful, it'll be a very tall order to get past the fabled break-even point and create a fusion reaction that produces more energy than is needed to start it—and until that is achieved, pure fusion power is just a lab experiment.

Some observers think we'd be better off scrapping fusion altogether. "These technologies are a luxury we cannot afford," says Thomas Cochran, a senior scientist in the nuclear program at the Natural Resources Defense Council. "It's hard to see how you get from here to commercialization in any cost-effective manner." Alternative energy, on the other hand, can be deployed today: Wind and solar have essentially come to technological fruition, and money spent installing turbines and arrays would immediately begin to offset carbon emissions.

Even fusion's more ardent supporters agree that—given the technical issues plaguing each fusion approach and the high cost of building prototypes—it is still many years from reaching the point of adoption. "In the long run, it will be a winner. We just don't know when that time frame will be," says Stephen Dean, president of the nonprofit research firm Fusion Power Associates. "If we had a crash program, like the moon or the atom bomb project, we could do it in 15 to 20 years, but that's the most optimistic thing I can think of."

Other researchers say fusion might be most useful—at least in the near term—as a means of destroying waste from nuclear fission. University of Texas physicist Swadesh Mahajan and his colleagues are developing a hybrid fusion–fission reactor that shunts neutrons produced during fusion to a fission blanket that burns nuclear waste as fuel. "Producing energy by fusion is at best a very long-term project," Mahajan says, "but through this intermediary, we can become useful to the energy sector."

NIF's projected LIFE power plant will be designed to burn waste, too, and Helion is considering adapting its reactor to do the same in order to provide revenue from utilities sooner. It's easier from a technical standpoint than using fusion to produce energy, because achieving break-even is not necessary—and it could potentially help solve a long-standing problem. Using Sandia National Laboratories data, Helion calculates 50 fusion engines could incinerate the entire U.S. stockpile of nuclear waste in 20 years.

Regardless of the detours fusion may take, its backers remain determined to see their initial energy quest through to its completion. Both Moses and Wallace insist that fusion power is a key component of a sustainable global future. "When you have a chance to do something that's meaningful, you might as well go for it," Wallace says. "It's not just making another widget." If they pull it off, it will be more like engineering the seemingly unattainable: the ultimate solar energy, a plant that manufactures the power of the sun. **PM**

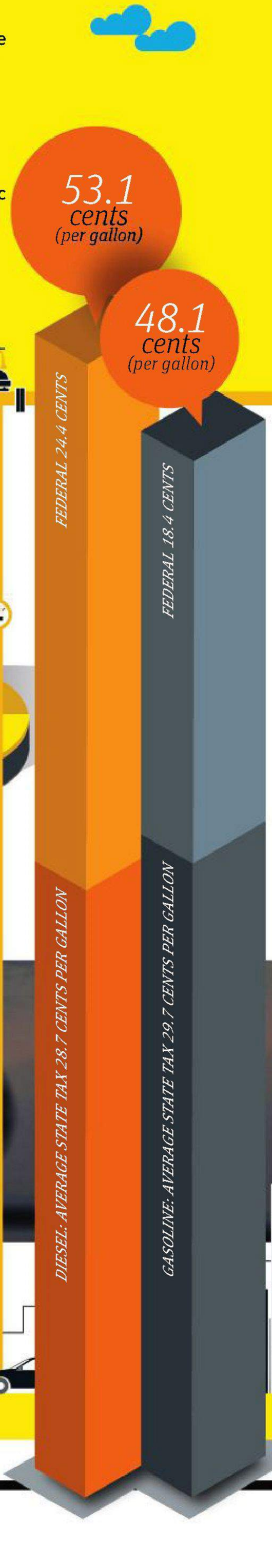


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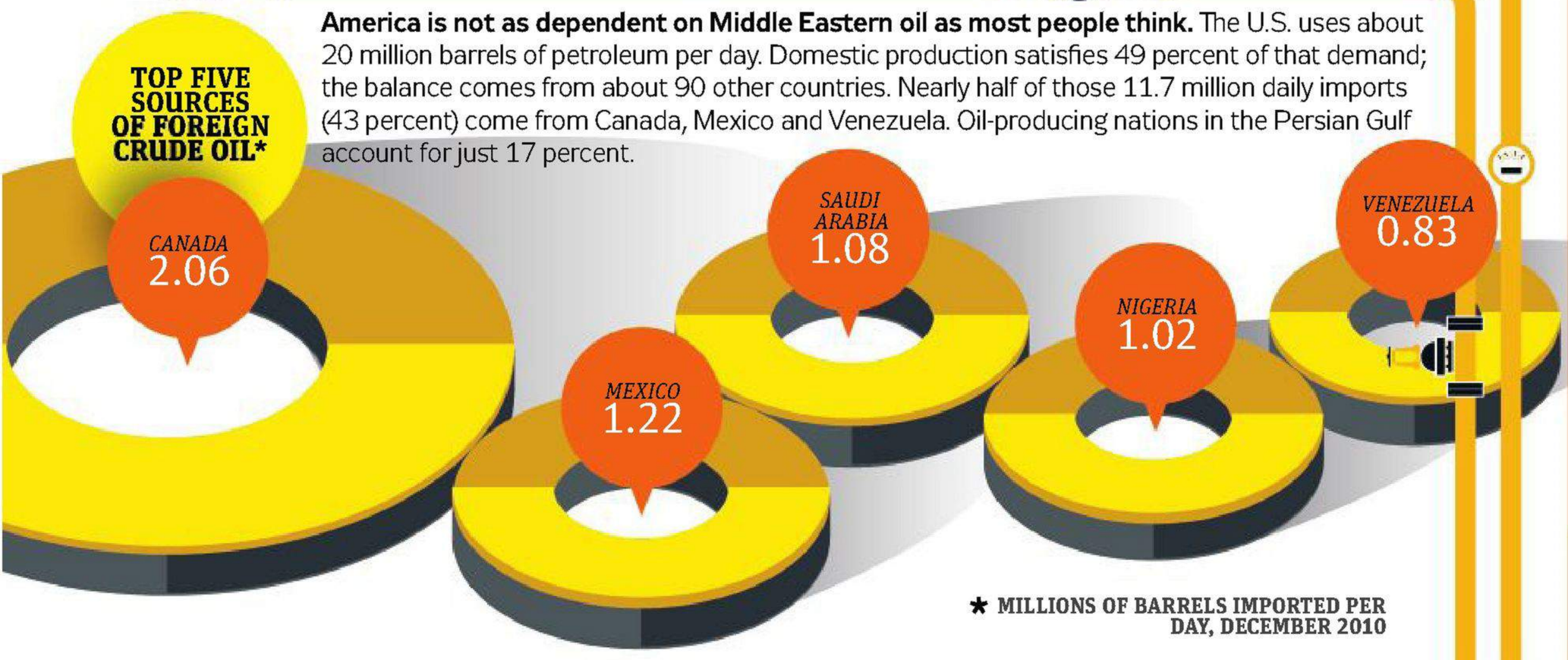
1. Cut Diesel Taxes

Diesel engines are about 30 percent more efficient than comparable gasoline engines. The EPA estimates that if one-third of Americans drove diesel vehicles, we'd save 1.4 million barrels of oil a day. So why aren't diesel engines creating the same buzz as hybrids? "People think diesel is very dirty because of the old days," says Lucian Pugliaresi of the Energy Policy Research Foundation. In fact, the transition to ultralow sulfur diesel, completed last December, means that diesel fuel now has at least 97 percent less sulfur. But federal excise taxes are higher on diesel than on gasoline (see chart at right), hampering its adoption. State taxes are lower on average, but that could change. For example, this year the Arkansas House of Representatives approved a bond measure asking voters in 2012 to pass a nickel-a-gallon tax increase on diesel. The public should realize that raising these fees would undercut a technology that squeezes more energy out of each barrel of oil.



Reality Check

America is not as dependent on Middle Eastern oil as most people think. The U.S. uses about 20 million barrels of petroleum per day. Domestic production satisfies 49 percent of that demand; the balance comes from about 90 other countries. Nearly half of those 11.7 million daily imports (43 percent) come from Canada, Mexico and Venezuela. Oil-producing nations in the Persian Gulf account for just 17 percent.



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2. Stop Flaring and Venting Natural Gas

Each year, more than 300 billion cubic feet of natural gas—about 6 percent of the amount used in American homes—escapes or is flared off during the production, processing and storage of oil and gas. In the past, it wasn't economical to capture these "fugitive emissions." Better technology has changed that. Hy-Bon Engineering, for example, makes compressors that can handle the low-pressure gas escaping from crude oil storage tanks. That gas packs 2.5 times more heating power than typical pipeline natural gas, making it so valuable that the total cost of installing the equipment is usually paid off in six months. This one's a no-brainer.



Immediate

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Midterm

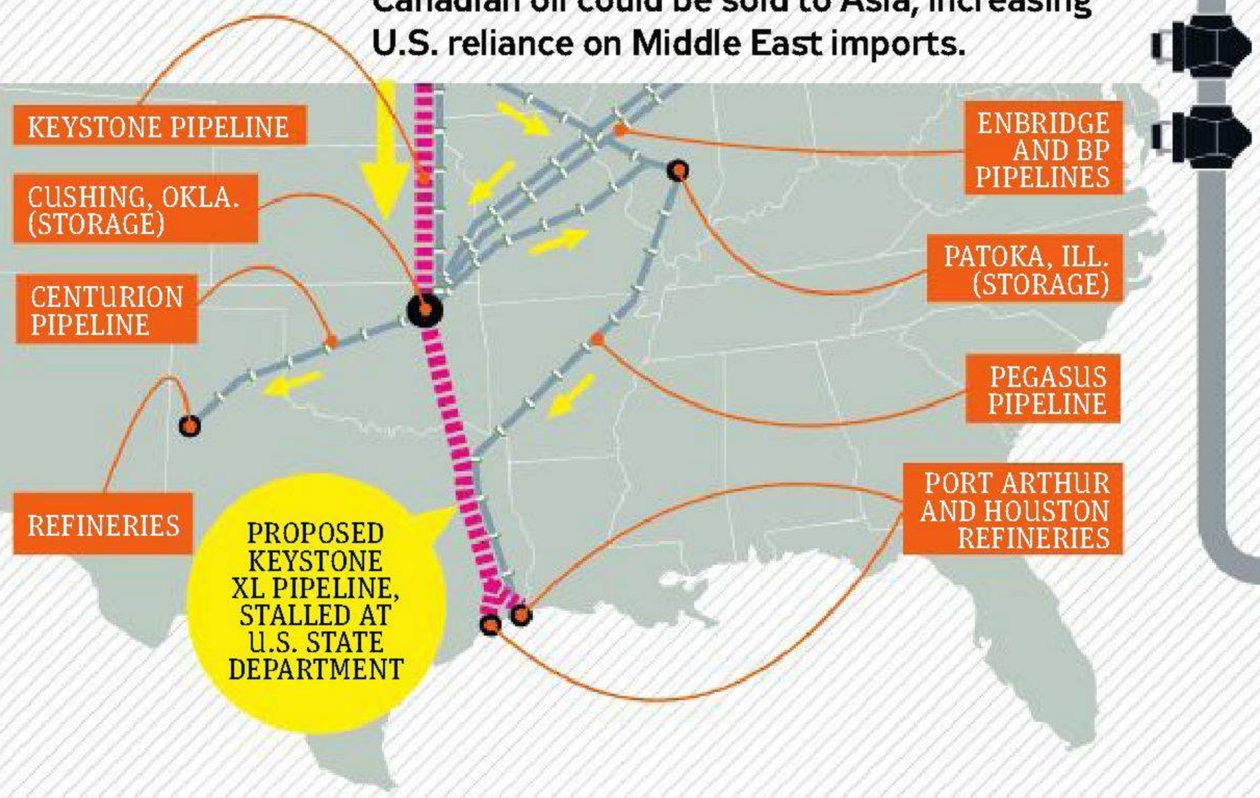
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Simplify Interconnection and Net Metering

One of the biggest barriers holding back those who want to make their own power is red tape. In many states, getting permission to plug into the grid (interconnection) and getting credit for power you feed into it (net metering) are expensive hassles. You should be able to use the grid like a bank, says James Rose, a policy analyst with the Network for New Energy Choices: Deposit power when you have an excess, and withdraw it as needed. Smaller generators (less than 10 megawatts) located close to where the power is used can take load off the electric grid, saving transmission losses. Easier grid access is a subsidy-free way to encourage all types of power equally, from solar panels to natural gas–powered cogeneration units.

4. Ease the Glut of Oil at Supply Hubs

Oil from Canada is piped into storage tanks in the Midwest before traveling to U.S. refineries. "The problem is that there are more pipelines going in than going out," says Marshall Adkins, an energy analyst with Raymond James Financial. To ease a record-breaking glut, TransCanada Corp. wants to build a pipe connecting Alberta to Cushing, Okla., and on to the Gulf Coast. This project, proposed in 2008, has been delayed by the U.S. State Department, despite approval by the Canadian government and a positive U.S. environmental impact report. The feds should not dither: Without the new pipeline, at least 1 million barrels a day of Canadian oil could be sold to Asia, increasing U.S. reliance on Middle East imports.



5. Promote Demand-Response Tech

Within an electric grid, timing is everything. "It's not how much power you use, it's when you use it," says Mary Ann Piette, who directs the Demand Response Research Center at Lawrence Berkeley National Laboratory. The biggest benefits of adjusting demand come with automation. Piette and her colleagues have spent nine years developing standards for how utilities communicate with buildings' controls. Each state must adopt standards individually, but researchers this year are agreeing on grid specifications that all states can share, easing widespread adoption. Piette says, "With minimal retrofit to controls, today's buildings can provide a significant reduction to their peak electric loads." Shifting load by just a few minutes can make a crucial difference—for example, temporarily dimming warehouse lights by 10 percent. Such technology can lower prices and reduce the need for new transmission lines and power plants.

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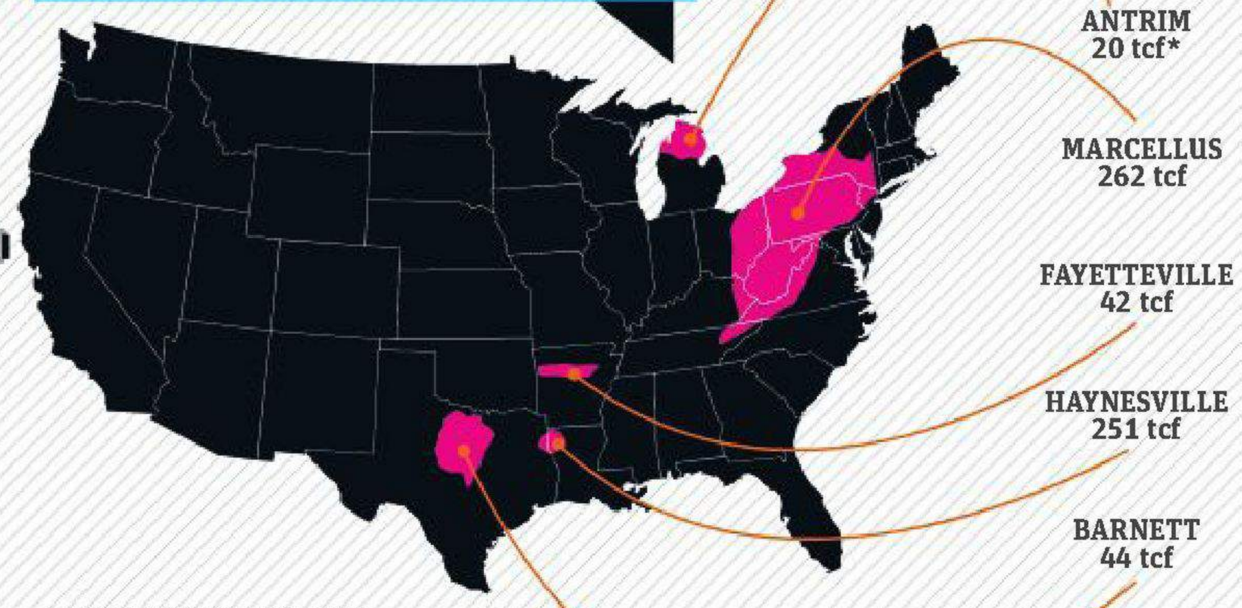
Popular Mechanics

6. Don't Touch the Emergency Oil Reserve

The U.S. stores 727 million barrels of crude oil in underground salt caverns in Texas and Louisiana, a reserve meant to be drawn down during a crisis. Over the years, however, whenever high gas prices have hit, politicians of all stripes have clamored for the president to open the spigot on this Strategic Petroleum Reserve. But releasing 4.4 million barrels of oil a day from the SPR—the maximum possible—would not reverse long-term trends that affect prices. And drawing down the reserve would leave the nation with one less option in case of extended interruptions in supply. That's why the SPR was created—not as a hedge against transient price spikes.

Reality Check

FIVE LARGEST PLAYS OF RECOVERABLE NATURAL GAS IN THE CONTIGUOUS U.S.



★ TRILLION CUBIC FEET

The United States has abundant sources of clean energy, ready to be tapped. A staggering 2552 trillion cubic feet (tcf) of natural gas exists in United States territory—and a single tcf can heat 15 million homes for one year or generate 100 billion kilowatt-hours of electricity. One important bonus: When burned, natural gas releases less carbon dioxide than oil and coal. Of the total potential natural gas in the U.S., 827 tcf come from shale. To tap these formations, called plays, drillers pump liquids and sand into wells, cracking the host rock, which releases hydrocarbons. Critics say this technique, hydraulic fracturing, contaminates groundwater with gas flowing up poorly sealed wellbores or with wastewater stored in holding ponds at the surface. The solution is not to ban fracking, but to improve the way it's done. Drillers need to upgrade operations—for example, by adopting nontoxic fluids to break rock and by recycling drilling fluid.

7 Combine Heat and Power Systems

Natural gas power plants are more efficient than coal-burning ones, but they still waste about half of the energy stored in the gas, emitting it as heat. Combined Heat and Power (CHP) systems use that excess heat to warm buildings, pushing overall efficiency above 90 percent. "You can also reduce grid losses and improve reliability," says Joel Swisher, a Rocky Mountain Institute researcher. Large buildings are ideal for CHP systems, but units for homes are emerging: Honda's Freewatt, based on tech that won a 2006 PM Breakthrough Award, this year got rave reviews during an EPA field test. The DOE wants to boost CHP from 8 to 20 percent of power generation by 2030; let's do it faster.

- NATURAL GAS 100%
- WASTE HEAT 5% TO 15%
- ELECTRICITY 10% TO 25%
- HOME HEAT 70% TO 80%

A GENERATOR PRODUCES ELECTRICITY; ITS EXCESS HEAT IS TRANSFERRED TO A BOILER. WITH NET METERING, ANY EXTRA POWER CAN BE RESOLD TO THE UTILITY COMPANY.

Long-term

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8. Kill Counterproductive Subsidies

$72 billion

FOSSIL FUEL SUBSIDIES

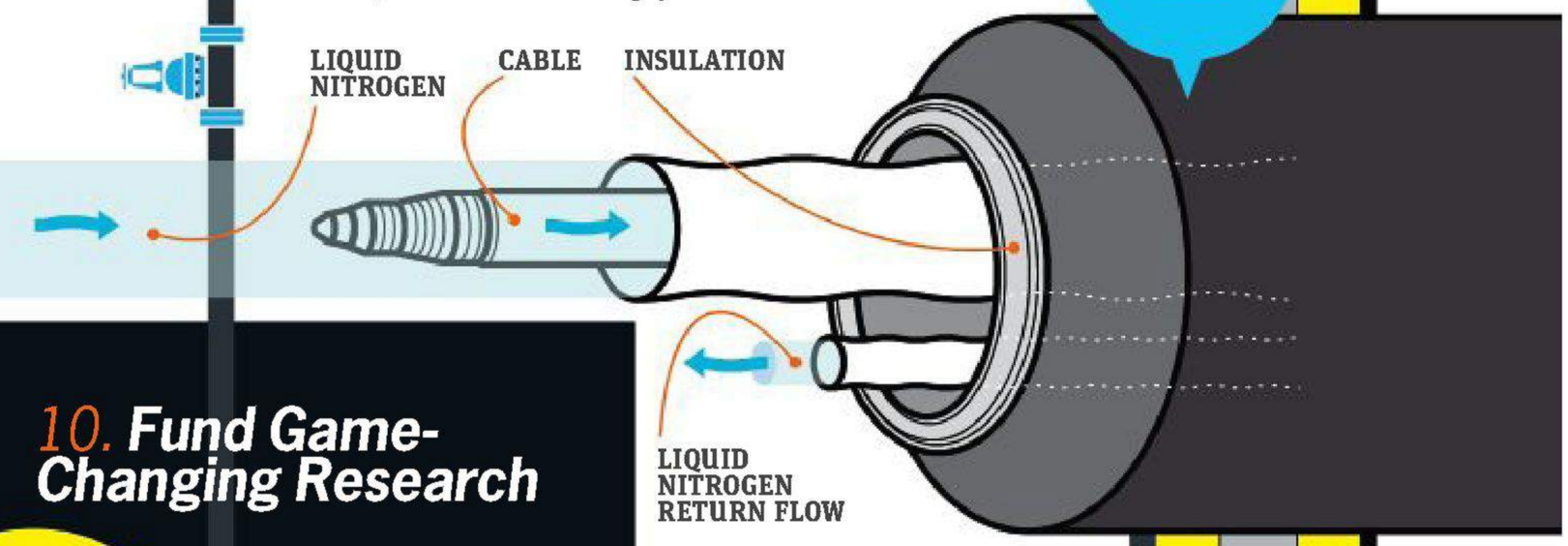
$29 billion

RENEWABLES SUBSIDIES

Politicians cite many reasons to subsidize American energy producers, including job creation, price moderation and new technology development. But they have to do a better job of killing handouts that do more harm than good. Of the $72 billion in subsidies that fossil-fuel producers received from 2002 to 2008, the largest ($15.3 billion) single source was a loophole in the Foreign Tax Credit that allows oil companies to deduct lease payments for drilling in places like Saudi Arabia and the United Arab Emirates from their U.S. tax bills. Over the same period, renewable fuel received $29 billion in subsidies—but more than half of that went to corn-based ethanol, which offers dubious net energy benefits, increases farm pollution and drives up food prices. Creating an industry from a politically expedient but unproven technology is not a good use of federal money; it is better to level the playing field and let the market choose the most successful technologies.

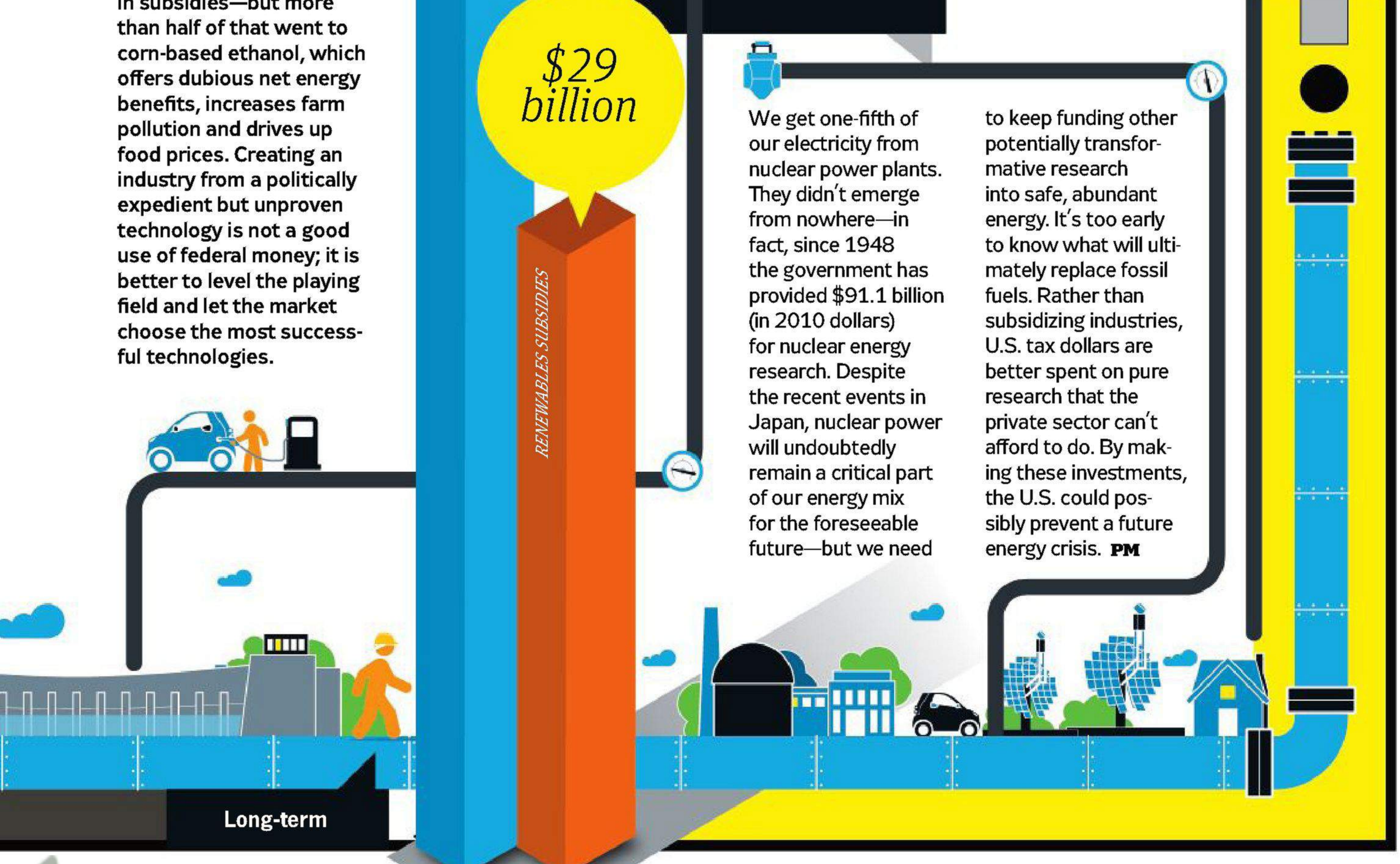
9. Build a Superconducting Transmission Grid

Eight years after the huge Northeast blackout, we're still talking about urgently needed improvements to the electric grid. Meanwhile, transmission losses squander about 7 percent of the electricity we generate, and traffic jams on the grid waste billions of dollars a year. Superconducting wire, which can conduct 100 times more current across supercooled lines than comparable copper wire, is the obvious next-generation solution. It takes seven to 15 years to build a new transmission line in the United States, mostly due to opposition from local residents to new infrastructure. But conventional lines require 200-foot right-of-ways, while a single superconducting line, capable of carrying the output of 10 nuclear plants, can be buried in just a 3-foot right-of-way. Fixing the grid is unavoidable; let's do it with 21st-century tech, not 20th-century patches.



10. Fund Game-Changing Research

We get one-fifth of our electricity from nuclear power plants. They didn't emerge from nowhere—in fact, since 1948 the government has provided $91.1 billion (in 2010 dollars) for nuclear energy research. Despite the recent events in Japan, nuclear power will undoubtedly remain a critical part of our energy mix for the foreseeable future—but we need to keep funding other potentially transformative research into safe, abundant energy. It's too early to know what will ultimately replace fossil fuels. Rather than subsidizing industries, U.S. tax dollars are better spent on pure research that the private sector can't afford to do. By making these investments, the U.S. could possibly prevent a future energy crisis. **PM**



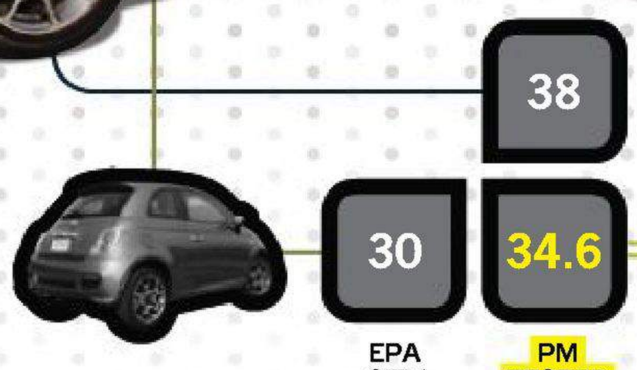
ENERGY FUTURE

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FIAT 500





FIAT'S NEW-FOR- America 500 was an outlier in this test: a three-door hatch up against comparatively roomy four-doors; sport-themed up against plain wrappers; and with a mere five manually shifted gears matched to six-speeders. Beyond that, it had the lowest EPA ratings: 30/38. What the 500 has is personality. Its retro body, bolt upright cabin, dinky wheelbase, narrow width and 195/45R16 tires on aluminum wheels make it look like a Sardinian skateboard. It's a high-style microcar that competes with the Mini Cooper and, maybe, a high-end Vespa. There's a toy-like countenance to the 500 that makes it quite effective at slicing through traffic and attacking off ramps. The 101-hp engine uses Fiat's MultiAir variable valve-lift system to increase efficiency, but the motor works hard, so the 500 is not the fuel-economy champ in this group. There's no surplus of oomph—but enough to make the 500 drive as spunky as it looks.

STATS

PRICE (BASE/AS TESTED): **$18,000/$18,150**
POWERTRAIN: **101 hp/ 98 lb-ft 1.4-liter I4, 5M**
WHEELBASE (in.): **90.6**
LENGTH (in.): **139.6**
ACCELERATION (sec):
0–60 mph: **10.18**
40–70 mph: **8.82**
QUARTER-MILE (sec/ mph): **17.26 @ 77.54**
BRAKING, 60–0 mph (ft): **125.6**
SLALOM (mph): **70.1**
LANE CHANGE (mph): **54.6**
SKIDPAD (g's): **0.85**

+ With the 500's cute face and engaging character, it's easy to overlook the fact that it's a fuel-efficient and reasonably priced car.

FORD FOCUS SFE





WITH ITS SCULPTED flanks and radical windshield slope, the Focus looks like a 21st-century small car. The SFE model is tricked out for fuel economy. The 2.0-liter engine features direct fuel injection—good for a 10 percent efficiency gain, Ford says—and is coupled to an automated twin-clutch six-speed gearbox that drives low-rolling-resistance tires. Opening the Focus's thick, triple-sealed doors is like peeling back a Tupperware lid. But despite that sensation of solidity, the Focus was the most consistently economical car on PM's road trip. Its 38.6-mpg performance was second only to the diesel Jetta's, which is very satisfying for a car that is accommodating, quiet and the quickest sprinter to 60 mph. Throw in neat Ford stuff like Sync, LED interior lighting, Millennium Falcon instrumentation and a $20,780 as-tested price, and the Focus becomes impossible to ignore.

STATS

PRICE (BASE/AS TESTED): **$18,490/$20,780**
POWERTRAIN: **160 hp/ 146 lb-ft 2.0-liter I4, 6 auto-manual**
WHEELBASE (in.): **104.3**
LENGTH (in.): **178.5**
ACCELERATION (sec):
0–60 mph: **8.02**
40–70 mph: **5.97**
QUARTER-MILE (sec/ mph): **15.82 @ 87.60**
BRAKING, 60–0 mph (ft): **119.6**
SLALOM (mph): **69.1**
LANE CHANGE (mph): **48.3**
SKIDPAD (g's): **0.82**

+ Developed in Europe, the new Focus delivers snappy accelera-tion, sporty dynamics and high fuel economy.

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HIGH MILEAGE TEST

Batteries Not Included

It seems like hybrids and electric vehicles have been hogging the efficiency spotlight lately. But while trend watchers have been focused on exotic technologies, carmakers have been quietly boosting the performance of the good old internal combustion engine. Here are five high-mileage cars that offer fun and refinement—and cost far less than most hybrids.

By John Pearley Huffman
PHOTOGRAPHS BY MARK PETERSON

Just a few years ago, the only cars wearing a 40-mpg EPA sticker carried an expensive electric–hybrid system. But automakers are responding to higher fuel prices—and tougher CAFE (Corporate Average Fuel Economy) regulations—by engineering improved fuel efficiency into nonhybrid vehicles, like the five we've tested here.

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MANY OF US DON'T VOTE regularly, rarely petition the government, have no need of speechmaking and can't make it to our houses of worship every week. But millions of us drive and go where we want, when we want—it's one way we Americans express our freedom. Today's challenge, with gas prices rising, is to stay on the road while burning less fuel. And the best way to do that isn't necessarily with a hybrid.

The number of nonhybrid vehicles carrying EPA highway mileage ratings near 40 mpg is rapidly expanding. A year ago, the only gasoline-fueled vehicle rated higher than that was the teetering Smart Fortwo, which carries two people in a cramped and noisy cabin. Today, the all-new Chevrolet Cruze Eco, Ford Focus SFE and Hyundai Elantra all hit 40 or better while comfortably seating up to five. And Fiat has returned with its stylishly reinvented 500 close behind them at 38 mpg. So, skipping the impractical Smart, PM recruited examples of the newer four for this comparison.

The diesels are back too. The latest is VW's 2011 Jetta TDI, with a new, larger body optimized for America. So we invited one.

That's five cars and not a single heavy, expensive battery pack among them. All five use strategies both venerable and modern to stretch their mileage. Gearboxes with long overdrives aren't new, but computer-automated, dual-clutch six-speed manual transmissions are. Low-rolling-resistance tires are an old trick, but now they're paired with aerodynamic body elements that automatically open and close with air speed. And direct injection, turbochargers and variable valve timing are all exploited in new, innovative ways.

Hybrids are optimized for stop-and-go driving where their battery assists and regenerative braking pay dividends. They make great taxis. But these five cars love the open road. So the essential element of PM's test was a meandering trip through California's midsection, from Santa Barbara to San Francisco. Along the way, we plied city streets, highways and two-laners to get a real-world assessment of how much fuel these cars drink. There's still plenty of adventure left on America's roads. And these cars grab it while delivering somewhere near 40 mpg.

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CHEVROLET CRUZE ECO





28	42	36.7
EPA CITY	EPA HWY	PM TESTED

FORGET CHEVROLET'S star-crossed small cars of the past. The new 2011 Cruze Eco flat works. Like the Focus, the Cruze Eco features aerodynamic slats behind the grille that automatically open at low speeds to keep the engine cool, but then close when cruising to reduce drag. And, of course, it has low-rolling-resistance tires. The star here is a 138-hp, 1.4-liter turbo motor that performs like a much larger engine. To enable the Cruze's 42-mpg highway rating, the Eco's engine is lashed to a six-speed manual transmission, with overdrive ratios for the top three gears. At a steady 70 mph, the tiny engine is only turning about 2000 rpm, but even the slightest grade can mean downshifting to third. The Cruze's rear seat is tight, but the interior mixes interesting textures and quality switchgear. On the outside, the Cruze wears beautiful crimson paint and blingitty-bling chrome wheels. It looks expensive, yet carries a modest $19,745 sticker.

STATS

PRICE (BASE/AS TESTED): **$18,895/$19,745**
POWERTRAIN: **138 hp/ 148 lb-ft 1.4-liter turbo I4, 6M**
WHEELBASE (in.): **105.7**
LENGTH (in.): **181.0**
ACCELERATION (sec):
0–60 mph: **8.55**
40–70 mph: **6.96**
QUARTER-MILE (sec/ mph): **16.31 @ 84.46**
BRAKING, 60–0 mph (ft): **129.1**
SLALOM (mph): **72.5**
LANE CHANGE (mph): **50.6**
SKIDPAD (g's): **0.80**

+

With a refined chassis and well-executed interior, the Cruze Eco is GM's most impressive small car ever.

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HYUNDAI ELANTRA





EPA CITY 29 | EPA HWY 40 | PM TESTED 32.3

HYUNDAI'S ALL-NEW 2011 Elantra features aerodynamically slick "fluidic sculpture" styling with solid hardware—a new 148-hp engine, an optional six-speed automatic that delivers the same fuel-economy ratings as the manual, six airbags, plenty of standard features and a USB port for plumbing into the sound system. This is a well-done conventional car that's just not pioneering anything. The interior decoration is restrained, the materials are high-quality (almost like a Honda's), and the controls are logically arrayed. Even back-seat passengers shouldn't complain. Much. Beyond that, the Elantra rides comfortably, is quick enough to stay out of trouble and handles okay even if the electric power steering is a bit numb. The Elantra is not sporty; rather, it's quiet and comfortable. The fuel economy was the lowest of the group, but with an as-tested price of $17,760, Elantra buyers can afford a few extra gallons.

STATS

PRICE (BASE/AS TESTED): **$17,080/$17,760**
POWERTRAIN: **148 hp/ 131 lb-ft 1.8-liter I4, 6A**
WHEELBASE (in.): **106.3**
LENGTH (in.): **178.3**
ACCELERATION (sec):
0–60 mph: **8.89**
40–70 mph: **6.89**
QUARTER-MILE (sec/ mph): **16.48 @ 84.10**
BRAKING, 60–0 mph (ft): **122.4**
SLALOM (mph): **69.3**
LANE CHANGE (mph): **50.4**
SKIDPAD (g's): **0.81**

+ Like the Sonata, Hyundai's Elantra provides a handsome body and an efficient powertrain in a low-price car that doesn't feel cheap.

VW JETTA TDI





EPA CITY 30 | EPA HWY 42 | PM TESTED 40.4

VOLKSWAGEN'S turbodiesels remain boutique items here in America. With the new Jetta, however, that boutique is looking like a Walmart. The Americanized Jetta is bigger and roomier than the previous model, and a simpler beam axle has replaced the independent rear suspension. That change won't affect most buyers. However, each one will notice how the new Jetta's interior feels cheaper and seems more antiseptic than we're used to in VWs, a consequence of the gas-powered Jetta's $15,995 starting price. The diesel version has copious amounts of satisfying low-end torque, and it was the only car to top 40 mpg in our test. But as much as we love diesels, the Jetta is not far enough ahead to make it the obvious choice. Besides the $4000-plus premium for the TDI, diesel fuel is about 30 cents per gallon more expensive than gas, and it's still a chore finding filling stations that stock the fuel. **PM**

STATS

PRICE (BASE/AS TESTED): **$24,965/$24,965**
POWERTRAIN: **140 hp/ 236 lb-ft 2.0-liter turbodiesel I4, 6M**
WHEELBASE (in.): **104.4**
LENGTH (in.): **182.2**
ACCELERATION (sec):
0–60 mph: **8.77**
40–70 mph: **6.95**
QUARTER-MILE (sec/ mph): **16.41 @ 81.96**
BRAKING, 60–0 mph (ft): **112.6**
SLALOM (mph): **72.2**
LANE CHANGE (mph): **51.5**
SKIDPAD (g's): **0.85**

+ The Jetta is the only small sedan available with a diesel engine, and its cruising efficiency suits Americans' love of road trips.

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THE GREAT OUTDOORS

PM GOES NATIVE AT CABIN BLUFF, A HUNTING AND FISHING RETREAT IN COASTAL GEORGIA, AND PINPOINTS OTHER PRIME MULTISPORT DESTINATIONS ACROSS THE COUNTRY.

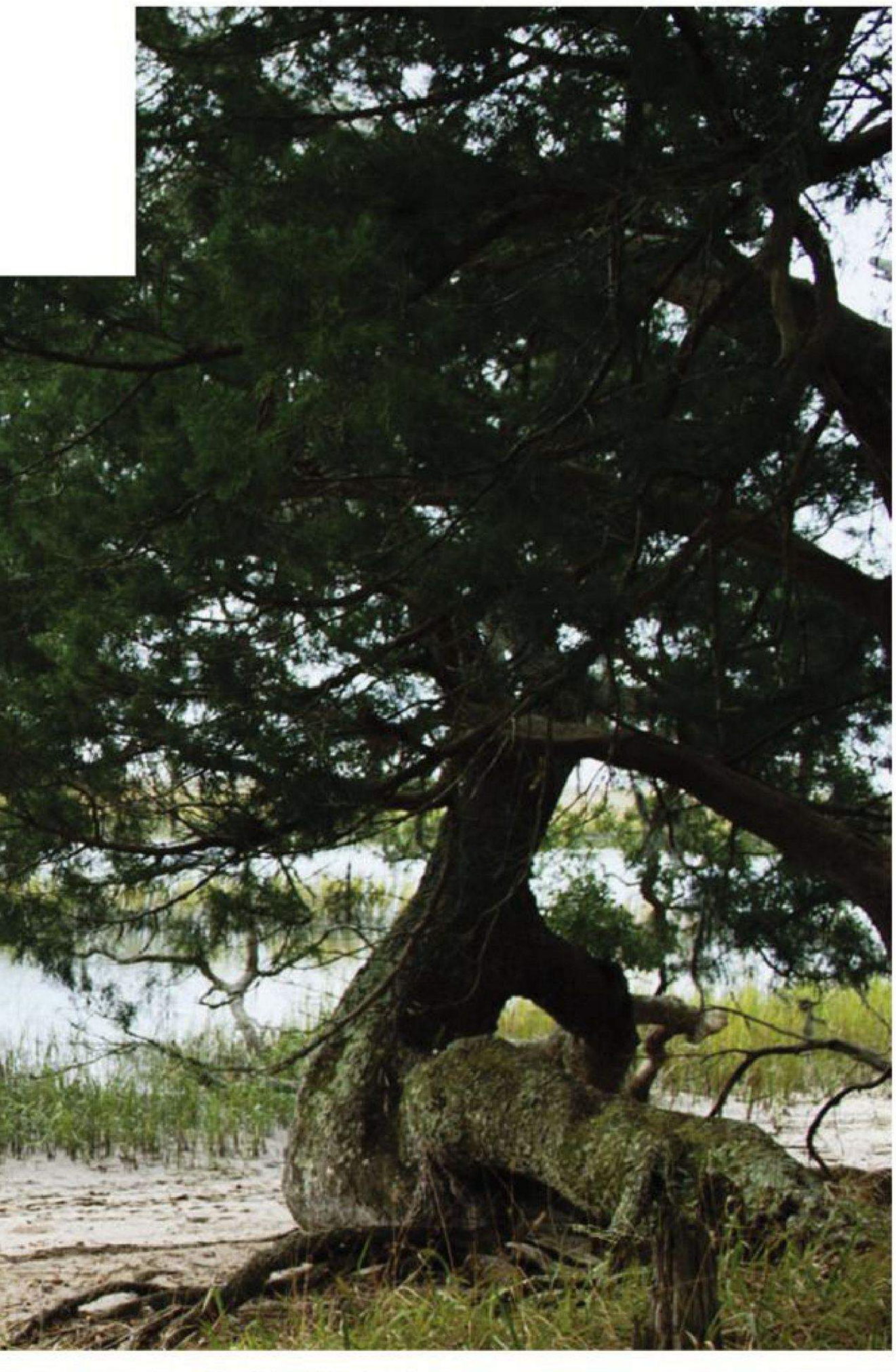


BY MATT HENDRICKSON | PHOTOGRAPHS BY SARAH SHATZ | STYLING BY INESSAH SELDITZ

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Clay pigeons (like the orange one shown at left) aren't the only targets at Cabin Bluff, where quail abound in the fields beside the Cumberland River. Kayaking and fishing are also popular at the retreat; a pickup truck with a roomy bed—such as the Ford F-150 SVT Raptor, below—comes in mighty handy for hauling gear.







COASTAL GEORGIA

You know the kind of sleep that's so deep you wake up wondering where you are? I remember, before dropping into the abyss last night, the patter of raindrops on the cabin roof and a whiff of salt air. Now the sun is peeking into my room through wooden blinds. I rewind and add up the details: I'm at Cabin Bluff, on the Georgia coast, my base camp for a few days of bonding with nature. Bleary-eyed, I shuffle to the dining room, grab a mug of coffee and head out to the dock on the Cumberland River. The cool air warms up slowly as the sun rises over the marsh.

The water is as still as a wing-shot quail. A few egrets glide past me, flashes of snowy white. The strong coffee shakes the cobwebs from my head. All of a sudden—*boom*! Evidently some early risers are getting in a few pre-breakfast shots on the 13-station sporting clays course. I wander toward the noise and meet up with Scott Revels and Seth Brock, two locals with Beretta 20-gauges slung over their shoulders.

"Wake y'up?" Scott says, smirking.

"No, just scared the hell out of me," I reply, my heart thudding in my chest.

BEACH GETAWAYS ARE FINE, even if all you do is bodysurf and dip into the cooler of beers at your feet. Or maybe you've taken the family for a theme-park experience—also fine, but not the kind of trip that frees your mind and feeds your soul. To accomplish that, you need to head outdoors and get the blood pumping in a place that naturally lends itself to multiple activities. Cabin Bluff fits the bill. Michigan's Howard E. Coffin—a pioneer in the automotive and aviation industries—bought Cabin Bluff, a game preserve and playground for the rich, in 1928.

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Today, the compound is more accessible but retains its rustic charm; little time here is spent idly, which was also true back in the day. Sporting clays, pedal kayaking and fishing are on my to-do list. There are also bike trails and a six-hole golf course on-site (though I won't have time to enjoy them). In fact, much of the territory around Cabin Bluff—along the coast and a tad inland—is dotted with places that suit the one-location, many-activities concept, whether you prefer hunting, hiking, boating or off-roading.

Right now I can't wait to get my hands on a shotgun. I wolf down some eggs and grits, find Scott and gear up (Cabin Bluff provides outfitting, or you can BYOG: bring your own guns); then we motor a half-mile in his pickup to the course. At the first few stations, clays fly out of shacks along the shoreline, propelled by throwers operated via remote controls on the shooting platforms. The clays' speed and flight paths differ, mimicking various fowl. I have some shooting experience, but eight clays whiz by before I nail one; Scott knocks out six in a row.

"You're waiting too long," he says. "You gotta pull the trigger sooner."

I had been holding fire until the clay passed its apex and began its descent—and thus was farther away and effectively smaller. So, the quicker the shot, the larger the target. I adjust my thinking and hit two out of three.

As Scott and I stroll along the piney path that connects the shooting stations, Seth and another friend, Josh Williams, join us. All three guys grew up on nearby St. Simons Island; they've been hunting and fishing these parts since they learned how to walk. Now they're my base-camp buddies, and we hit a few more stations, including one where the clays skitter along the ground like a rabbit: Shooting clays is fun *and* good hunting practice.

With river fishing and kayaking planned for the afternoon, Scott, Seth, Josh and I put up our guns, grab lunch at the main cabin—the nucleus of a cluster of eight guest cabins set among a grove of pines, live oaks and palms and just a short walk to the riverbank. This is the beauty of the base-camp concept: Regardless of what outdoor sport you choose to indulge in, the action is always close at hand.

Outfitter Michael Gowen is waiting for us at the sandy staging area at the river's edge. He presents us with a range of watercraft, including a pedal kayak, which is like a recumbent bike on the water. It keeps a fisherman's hands free for casting, but I just like the fact that it's really fast. "People go for miles in these things," Michael says, nudging me away from the riverbank.

Once I find my lane, I'm skimming along at a wicked clip. Soon my thighs are burning, and I'm out of visual range of the other guys, who are fishing closer to land. I whip around and book back toward them, trying to hit the put-in point but blowing past it; the craft is fast yet hard to control. I glide to a halt, then circle back and beach the kayak, pouring sweat. "That's one helluva ride," I say, dismounting and heading to my cabin for a breather.

At twilight I hear pounding on my door and the rallying cry: "Oyster roast!" Following Southern tradition, Cabin Bluff has laid out a spread of oysters, seafood chowder and more for a sunset feast. I'm not big on oysters, but I shrug and do as the natives do. I grab one from the pot, split it apart,

how to **SHOOT SPORTING CLAYS**

Jon Kent is the manager of the Sea Island Shooting School, near Cabin Bluff. Here are his five basics:

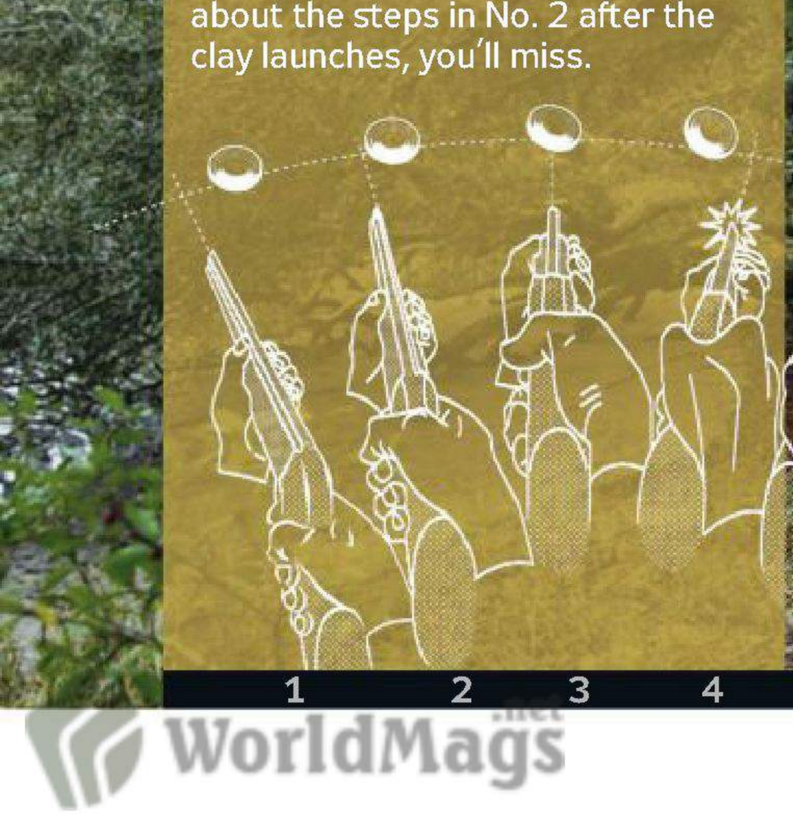
1. You don't aim a shotgun; you point it, as if it were an extension of your index finger.

2. Before the clay flies, note the hold point (the spot along the clay's path where you first point the gun), the focal point (where you will first see the clay) and the break point (where the clay will be when you fire).

3. Call "pull" and focus on the clay—and only the clay.

4. When the clay hits the hold point, swing the gun along the flight path to the break point.

5. Clear your mind. If you think about the steps in No. 2 after the clay launches, you'll miss.





1 2 3 4 5

ILLUSTRATION BY DAVID SANTANA

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PM

OUTDOOR ESSENTIALS

Many sporting retreats provide all the gear you need—shotguns, boats, kayaks, fishing tackle and more—but if you want to acquire your own arsenal, here are a few possibilities.



Mossberg SA-20 Semi-Automatic 20-Gauge
$496 | *mossberg.com*

Ruger Red Label 20-Gauge Over/Under
$2015 | *ruger.com*



Native Watercraft Ultimate 12 Propel
$2099 | *nativewatercraft.com*

Heritage RedFish 12 Fishing Kayak
$779 | *heritagekayaks.com*



Shimano Spheros FB Spinning Reel
From $110 | *basspro.com*

Frequent Flyer Fly/Spin Rod Combo
$369 | *orvis.com*

add some cocktail sauce and horseradish and . . . down the hatch. It tastes as if the natural environment were distilled into this salty, earthy morsel. Later, filled to the gills, we sit outside around a roaring fire, enjoying a few beers. After midnight I amble back to my cabin, anticipating the morning wake-up call to go ocean fishing.

I'm a bit late for the appointed 7 am launch, but I'm not the only one. All of the base campers are guilty of having overindulged last night. Regardless, we shuffle to the dock, where our guide, Toby Mohrman, wearing a bright yellow rain jacket, stands on the deck of a 26-foot Sea Cat. "Y'all got after it last night, huh?" he says with a sly smile.

We murmur and nod, grabbing the poles and settling in for the short ride downriver to the open sea. We're a bit out of season for this type of fishing; in late spring, when the water is warmer, tarpon, king mackerel and black bass abound, Toby says. But now our casts yield just a few nibbles, and the drizzle becomes a steady pour, so Toby steers us back upriver and docks at Cabin Bluff. "Lay off the booze and get your butts out here early next time," he chides us good-naturedly.

He's right, of course, and I silently vow to return someday to this hidden paradise. Beach vacation? Nah. This is where the action is.

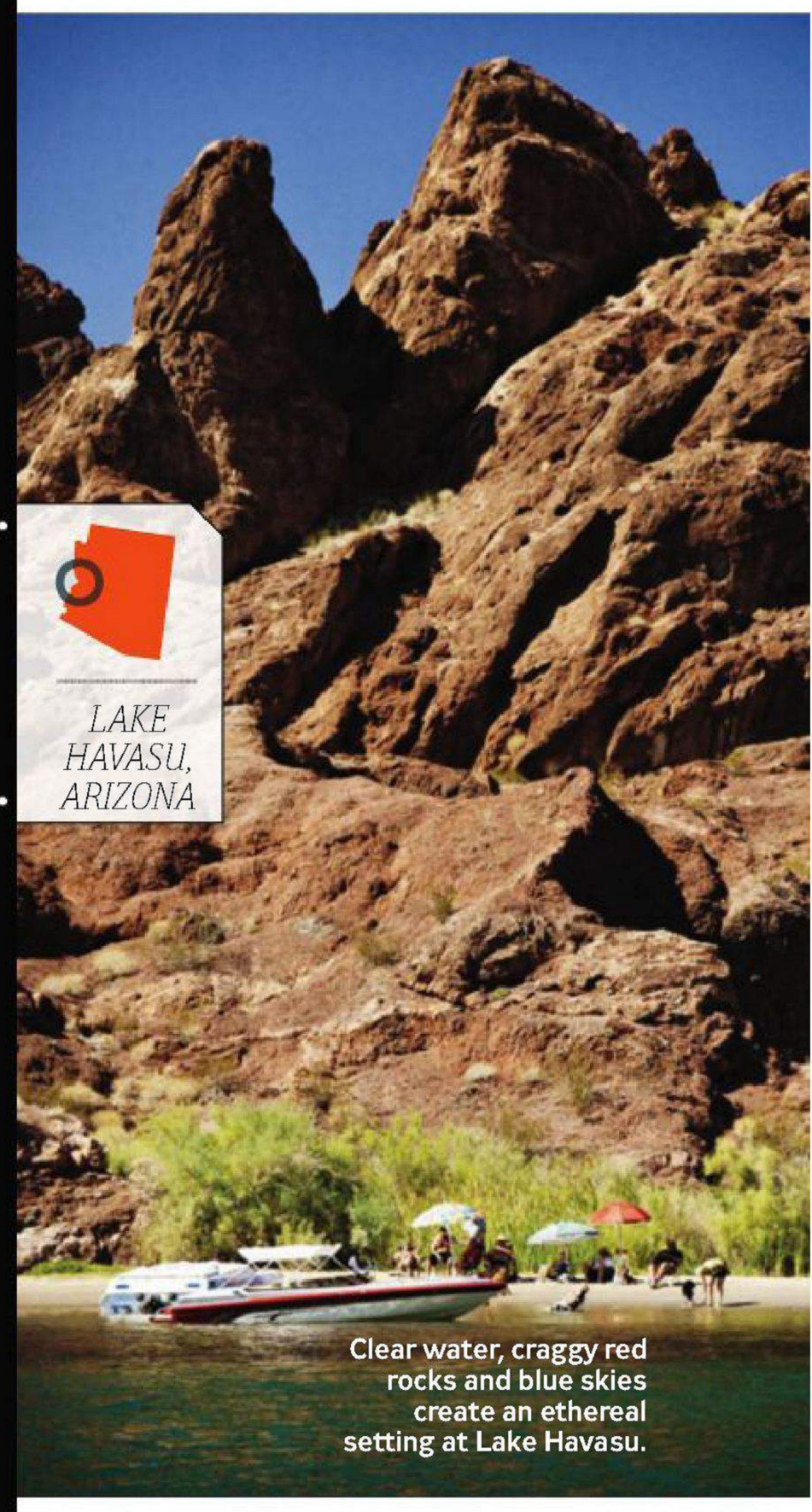
↘ **LOCAL KNOWLEDGE:** Coastal Georgia is damp and often rainy; evenings are cool, except in summer. Be sure to pack water-repellent and moisture-wicking clothing, and dress in layers.

where **TO STAY**

1. **RESORT** Cabin Bluff, from $450 nightly per person, includes all meals and most activities, with outfitting. *cabinbluff.com*
2. **HOUSE RENTAL** On nearby Jekyll Island, a home that sleeps six can be had for less than $1000 per week. *jekyll-island.com*
3. **CAMPING** Jekyll Island Campground is a haven by the sea; from $21 per night. *jekyllisland.com*

SINGLE LOCATIONS, MUCH TO DO

THREE MORE GREAT PLACES TO SET UP BASE CAMP



LAKE HAVASU, ARIZONA

Clear water, craggy red rocks and blue skies create an ethereal setting at Lake Havasu.

Although it's a major spring break destination, Lake Havasu—a 19,300-acre reservoir fed by the Colorado River and contained by the Parker Dam—manages to balance out the Jell-O-shot-quaffing and beer pong with a healthy dose of sun-drenched outdoor activity. Lake Havasu City is surprisingly quaint, replete with a reconstruction of the original 1830s London Bridge, reaching across the lake to Pittsburgh Point. (Robert McCulloch, the automotive pioneer and maker of the eponymous chain saw, had the bridge relocated here in

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1968.) Copper Canyon is the lake's party central; on the weekend, so many boats tie up here that you can literally walk on water. There are also plenty of quiet, isolated places to weigh anchor and chill out on the shore. If you want action, diving, waterskiing and fishing outfitters abound (for details, see *golakehavasu.com*). The Copper Basin Dunes, 1275 acres of sand hills and mountain trails maintained by the U.S. Bureau of Land Management, are off-roading nirvana (go to *blm.gov/az/st/en/prog/recreation/ohv/copper.html*).

PM
OUTDOOR ESSENTIALS



Kymco MXU 150 ATV
$2999 | *kymcousa.com*

Honda Rincon
$8799 | *powersports.honda.com*

LOCAL KNOWLEDGE: Dehydration is a real threat in the desert. Plan on drinking at least 3 liters of water a day, and even more if you're also enjoying some adult beverages.

where TO STAY

1 **RESORT** Havasu Dunes Resort kitchen-equipped one- and two-bedroom condos that sleep up to six, with on-site laundry, are just right for base campers. In Lake Havasu City; from $109 a night. *havasu-dunes.com*

2 **HOUSEBOATS** The town is loaded with chain motels, but why not take advantage of the natural surroundings and stay on a boat? *Lakehavasuhouseboating.com* offers a range of floating palaces.

3 **CAMPING** The beachfront Crazy Horse Campgrounds is in the thick of things; you can escape for a hike on the Sara Park Wash, where the Crack-in-the-Rock trail leads through a canyon before you arrive at the lake. *golakehavasu.com*



The Mount Hood area is among the most beautiful and geographically diverse outdoor-sports destinations in the nation, if not the world. It is possible—if you're an ironman, but nevertheless—to ski the Palmer Glacier (elevation: 7700 feet) in the morning, rock-climb the bolted crag of French's Dome in the afternoon and finish your day with a 100-foot free-fall off a bungee tower at the Adventure Park at Mt. Hood Skibowl before you hit dinner. While some areas can get crowded (the adventure park draws lots of families, plus skiing enthusiasts who need a summer fix), it's remarkably easy to get away from it all, and from everyone else, to enjoy the outdoors in this part of Oregon, about an 80-mile drive east of Portland (and two hours from that city's

LOCAL KNOWLEDGE: If you travel via Portland, stop for a meal at one of the city's many food carts; the Big Egg offers perhaps the world's best fried-egg sandwich. *foodcartsportland.com*

PM
OUTDOOR ESSENTIALS



Honda CRF230F
$3899 | *powersports.honda.com*

KTM 450 XC-W SixDays Edition
$8899 | *ktmusa.com*

where TO STAY

1 **RESORT** Rooms at the Lodge at Government Camp offer entrancing views of Mount Hood. From $199. *thelodgeatgovernmentcamp.com*

2 **HOUSE RENTAL** Cabins, vacation homes, bed-and-breakfasts: Take your pick, from lowball to five-star prices. *mounthoodinfo.com*

3 **CAMPING** Mt. Hood National Forest has 81 campgrounds. The Trillium Lake sits at the water's edge, the Tilly Jane at the base of the volcano. Call 503-668-1700.

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airport). A big part of Mount Hood's attraction for true outdoor enthusiasts is that while it is essentially a sprawling resort, it flies under the radar relative to other vacation destinations in the West, such as Vail and Aspen. (Upscale shopping near Mount Hood? Not happening.) The geographical feature that gives the area its name is an 11,200-foot, snow-covered, potentially active volcano. It serves as a beacon no matter what adventure yen you happen to be indulging. You can see the craggy white peak from McCubbins Gulch, site of one of the only legal dirt-biking trail networks in the area. (The U.S. Forest Service limits off-roading to a relatively small portion of the 1-million-acre Mt. Hood National Forest.) Given the steep elevation changes and numerous rivers around Mount Hood, the whitewater rafting is also topnotch. Clackamas River gets the most traffic, but outfitters also offer trips to the more remote Hood, Molalla and Sandy rivers.



Scrambling on the dunes, which reach as high as 450 feet, is a Traverse City tradition.

UPPER MICHIGAN

PM

OUTDOOR ESSENTIALS



Kawasaki Jet Ski 800 SX-R
$7899 | *kawasaki.com*

Sea-Doo RXT-X aS 260
$15,999 | *sea-doo.com*

The wooded ridges and 450-foot sand dunes along the shores of Grand Traverse Bay and Lake Michigan make this popular midwestern destination feel more western than one would imagine—it's like Big Sky country without the major trek to get there. Cool nights give way to warm summer days that seem to last forever: Here in the far north, the sun sets late, and darkness doesn't descend until well past 9 pm.

Traverse City proper has a kitschy side, proudly wearing the badge of cherry capital of the world, and orchards and food shops dedicated to the fruit abound in the area.

But the region is equally proud to be Michigan's outdoor playground. Watersports dominate the activities menu—for instance, zipping around on personal water vehicles on the lakes, or canoeing, tubing or rafting on the Pine, Boardman, Manistee, Crystal and Betsie rivers.

If you'd rather not get your feet wet, there's also plenty to do on terra firma. More than a dozen golf courses lie within 20 miles of Traverse City; hiking trails are plentiful in the area; and the gently rolling hills and well-maintained roads make for excellent touring by bicycle. **PM**

where **TO STAY**

1. **RESORT** Grand Traverse Resort & Spa is a cost-effective bet for a family or large group, offering hotel or house-rental accommodations. *grandtraverseresort.com*

2. **HOUSE RENTAL** There are literally hundreds of condo/home rentals—and numerous base-camp sites to pick from—in the Traverse City area. Check out *visitupnorth.com* to see the range of possibilities.

3. **CAMPING** There are 35 campgrounds within 30 miles of Traverse City. The Sand Lakes Quiet Area allows no motor vehicles, so it's ideal for tranquil hiking, biking and swimming. Timber Ridge is more action-packed. *michigan.org/places-to-stay/campgrounds/default.aspx?city=G3602*

LOCAL KNOWLEDGE: Bug repellent is a must; the mosquitoes and black flies will try to eat you alive. Also, bring a sweater or two; nights are chilly year-round.

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Their idea featured in the November 2011 issue of Popular Mechanics and a $5,000 cash prize

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When the First Responder Is You

IN AN EMERGENCY, THE FIRST STEP IS TO CALL 911, BUT THE ACTIONS YOU TAKE WHILE PROFESSIONAL HELP IS ON THE WAY CAN MEAN THE DIFFERENCE BETWEEN LIFE AND DEATH. HERE'S HOW TO STEP UP FROM INNOCENT BYSTANDER TO INSTANT HERO. By Kalee Thompson



NOT AS SEEN ON TV

THE FIREBALL: "On TV, when a car catches fire you usually get this huge explosion," says ex–British Commando Paul Burton, a veteran of war zones and natural disasters. Reality is less dramatic: "When fire builds up pressure in the fuel tank, the valve shoots off and a jet of fuel comes out and catches fire, but the car won't explode."

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SAVE SOMEONE FROM A BURNING CAR

It's late, and you're driving on a desolate highway. You see an orange glow in the distance—fire. Soon, you arrive at the scene. A car with a crushed front end has flames spilling from under the hood, and someone's trapped inside. You dial 911, and then . . .

CREATE A SAFE ZONE, says Ron Moore, a Texas fireman who has taught extraction techniques to first responders for 30-plus years. Seventy people die every year because of secondary collisions. So block the site with your own car and flip on the hazards.

ARM YOURSELF with a tire iron and, if possible, a fire extinguisher, and don gloves and protective clothing.

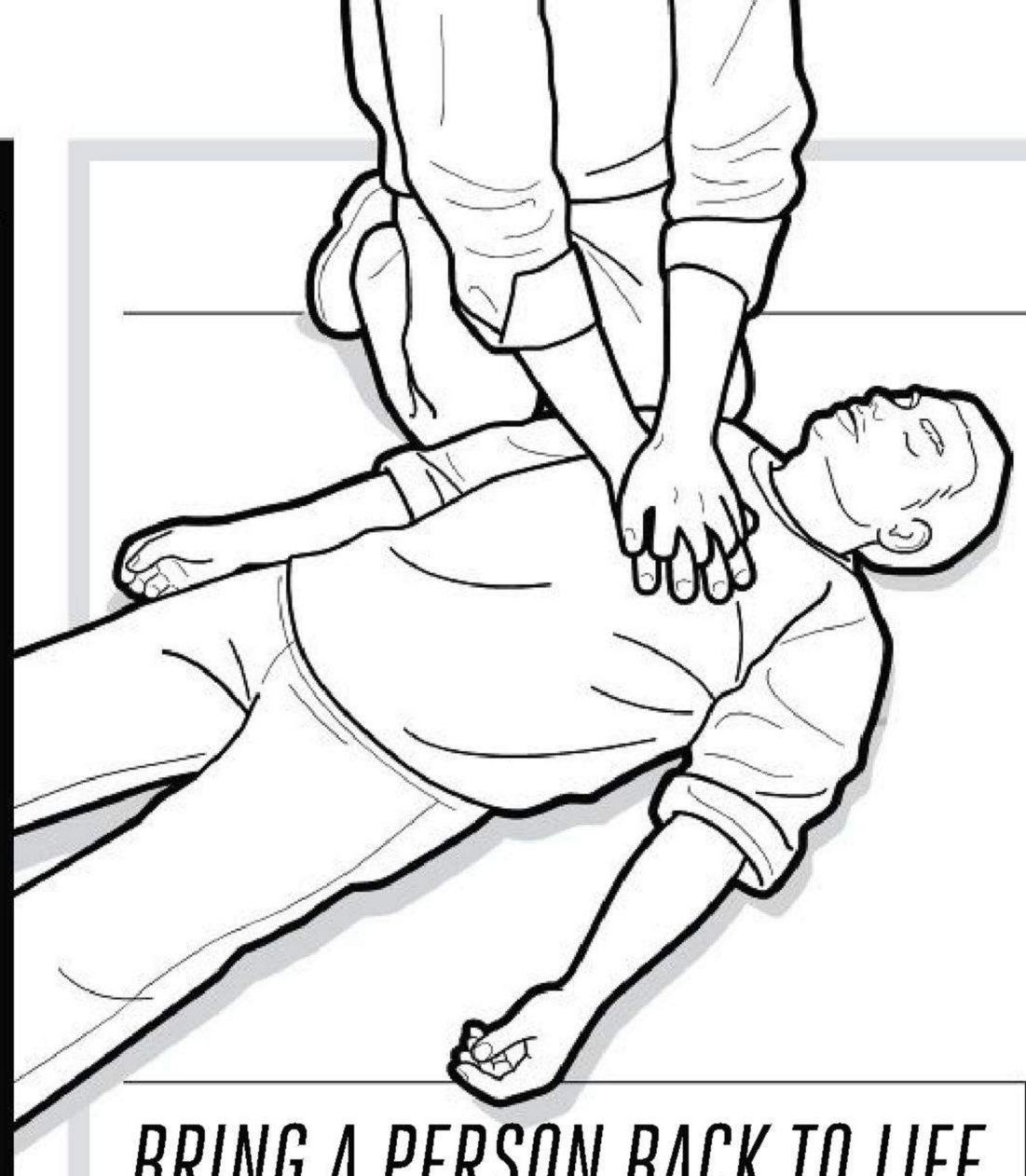
WALK—DON'T RUN—toward the crash. Running can cause an adrenaline and endorphin rush, and kill clear thinking.

FIGHT THE FIRE. Stand uphill and upwind of the flames and discharge your extinguisher along the base of the fire. No extinguisher? For a small blaze, scoop up snow or dirt to snuff the flames. Above all, be realistic. "You don't use a squirt gun to shoot an elephant," Moore says.

GAIN ACCESS. If the doors are locked, smash the window farthest from the victim by striking it low in the corner with your tire iron.

FREE THE VICTIM. Normally, you shouldn't move a crash victim, but if fire still threatens, hook your hands under his armpits, cradle his head and neck in your forearms, and gently drag him to safety. Keep the victim's head and torso aligned as you move him, in case of a head or spinal injury.

ILLUSTRATIONS BY SEAN HUDSON; DIAGRAMS BY MERCÈ IGLESIAS



BRING A PERSON BACK TO LIFE

For years, CPR instructors have drilled students with ABC: airway, breathing (mouth-to-mouth) and chest compressions. That approach got the boot last year, since the majority of adults who need CPR are cardiac victims, and studies have shown that they don't need mouth-to-mouth at all. A new, simpler method is designed to encourage anyone who witnesses an adult's collapse to help immediately with "hands only" CPR—chest pumps that keep blood circulating to the brain. (For a child or drowning victim, two breaths per 30 compressions are still advised.) No training is required, and good-Samaritan laws protect citizens trying to do the right thing. But once you start CPR, *do not* stop until the person stirs or professional help arrives.

1 • Cardiac victims may display seizure-like symptoms (fists clenching, arms straightening, and then fish-like breaths) before passing out. Immediately call 911 if you see this, then begin CPR right away.

2 • Lift up the victim's shirt, flatten your palms between his nipples and, with straight elbows, start pressing.

3 • Your palms should compress the chest cavity by one-third. Press rapidly: The recommended rate of 100 thrusts a minute just about matches the beat of "Stayin' Alive."

KNOW YOUR DEFIBRILLATOR

For most victims of cardiac arrest, CPR serves only to keep blood flowing to the brain until help arrives. An automated external defibrillator (AED) can jump-start a stopped heart. Now more common in public places, AEDs diagnose a patient before discharging and can guide a bystander through usage.



TALK SOMEONE DOWN FROM THE EDGE

Of the 35,000 suicides in the United States each year, several hundred are jumpers. At the Golden Gate Bridge last year, there were 32 suicides—but at least 75 more were prevented by trained officers or alert passersby. "If you encounter someone who is about to jump, the impulse is to become excited, to scream and run toward them," says Eve Meyer, executive director of San Francisco Suicide Prevention. She advises approaching potential victims calmly and never reaching out to grab them, which could precipitate a jump. Instead, ask, "Are you okay?" and then "Will you walk with me?" Switching the focus to yourself is the key: "People in crisis will do a favor for another person, even though they won't do something for themselves," Meyer says.

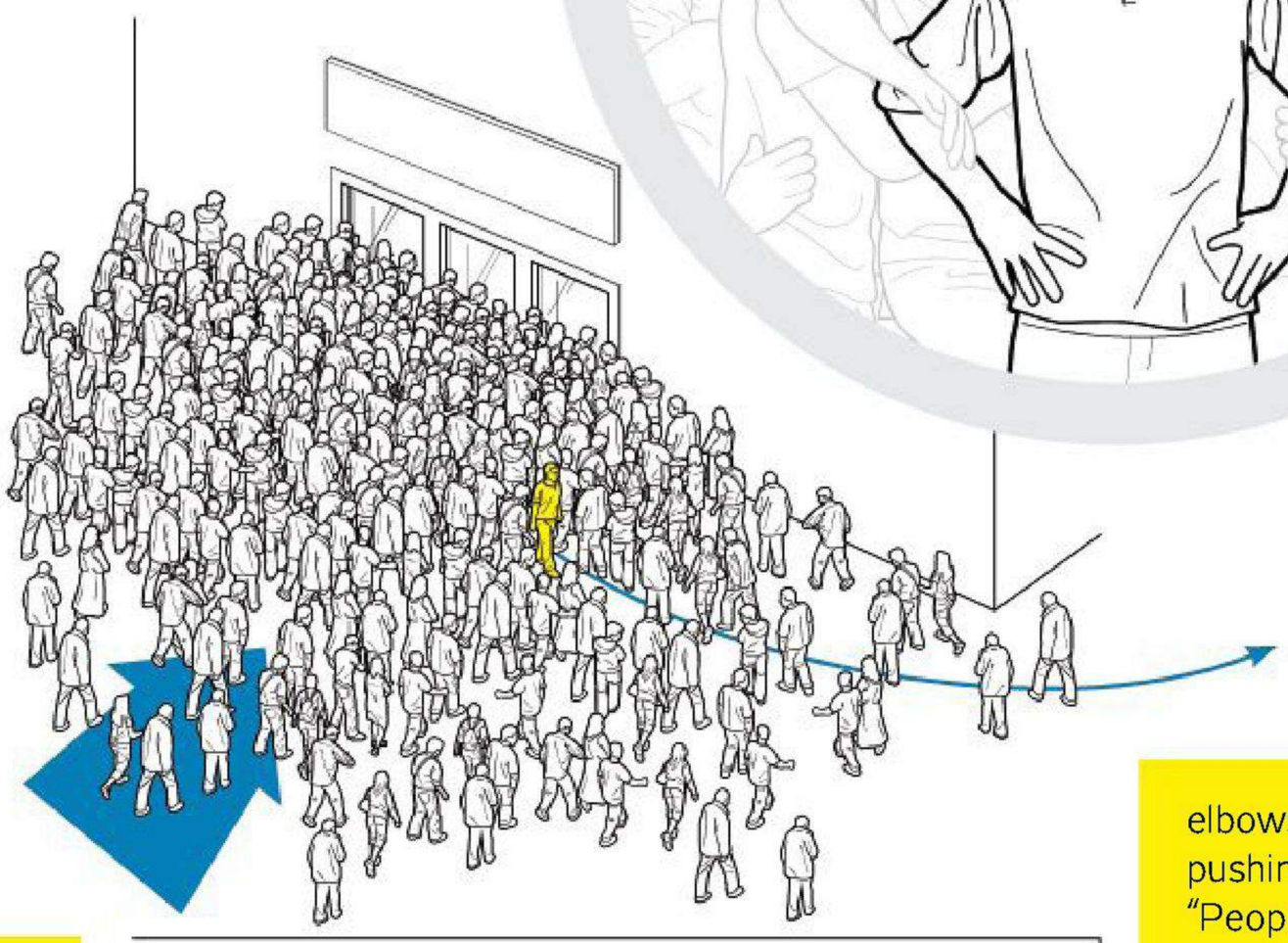
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AVOID THE SURGE Once you're trapped in a crush, it's difficult to escape, but if you sense that a crowd is getting dangerous, move perpendicular to the surge to reach the edge of the crowd.

PROTECT YOUR LUNGS The greatest danger in a crowd crush is compressive asphyxiation. Hold your arms akimbo to gain breathing room.





SURVIVE A CROWD CRUSH

"When a crowd starts to surge, it can collapse a concrete wall or easily push over a chain-link fence or other barriers you wouldn't even imagine," says James A. McGee, a stadium security expert and former FBI officer who consulted for the 2004 Summer Olympics in Athens, Greece. Just two or three guys pushing unknowingly at the back of the mob can easily create a ripple effect that will knock people over—and if you're inside the crush, you're pretty much at the mercy of the surge. "You're not going to be able to fight your way out," McGee says. Instead, try to buy yourself as much personal space as you can by keeping your arms at your side, bending your elbows and pushing out. "People suffocate in that environment. They can't even expand their lungs," McGee says. Counterintuitively, most crowd crushes occur when a mass of people is trying to get into a stadium, concert or store—not out. If you're at the front of a line, scope out an exit path before the crowd starts to move.



NOT AS SEEN ON TV



THE PANICKED PUBLIC

"Hollywood has a lot to answer for in terms of people running and screaming and crying [in a crisis]," risk and terror expert Dr. Brooke Rogers says. In fact, people generally tend to remain calm, even in the face of disasters like 9/11. "We call it the myth of the panic-prone public. Yes, some people get upset, but you find that the majority will try to comfort one another and cope together."

REACT TO A HOME INVASION

GET OUT. If someone has broken into your house, your very best bet is to flee, according to Fred Mastison, president of Force Options, an Arizona-based tactical and self-defense training firm. Of course, that may not be possible if, for instance, you're on the second floor or there are kids in the house. So Mastison recommends designating a "safe room" with a solid door, a deadbolt, a phone, a flashlight and tools to protect yourself.

ONCE YOU'RE IN THE room, call 911; stay on the line until help arrives. Let the intruder know you're home by yelling that police are on the way. An estimated 86 percent of home break-ins are robberies, many motivated by the need for drug money. Usually, criminals flee when they realize someone is home.

STILL, YOU MUST prepare for a violent confrontation, which is why Mastison teaches fighting and firearms skills. Using a gun for self-defense requires regular training and a willingness to use lethal force.

OTHERWISE, arm yourself with pepper spray or a civilian Taser. "I'm not a big fan of impact weapons," says Mastison, who advises against the use of baseball bats and knives: "They're a lot harder than you'd think to use against a dedicated adversary." The Taser, on the other hand, is a great tool: "Anybody and everybody can have a Taser now. I go through the tasing as part of my training, and it is debilitating. I'm a big cat, and it stops me dead in my tracks."



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KNOW YOUR TASER The civilian Taser C2 shoots electrode darts up to 15 feet. They transmit a high-voltage pulse to incapacitate an attacker. After the darts are ejected, the Taser can be used as a contact stun device.

SURVIVE A NUCLEAR EVENT

A modern nuclear disaster is less likely to come from an all-out nuclear war than from a power-plant radiation leak, like the one that resulted from the Japanese earthquake and tsunami, or from small-scale improvised "dirty bomb" weapons. If there is enough warning before an event, follow the evacuation instructions of authorities. But if a large-scale release of radiation has already occurred, stay put. Remaining inside a car for several hours could double your chances of survival; a windowless room inside a building is even better, and a basement is better still. "Go in, stay in, tune in" is today's mandate in any sort of chemical, biological, radiological or nuclear attack, explains Dr. Brooke Rogers, a lecturer in risk and terror in the Department of War Studies, King's College London. Fight the instinct to find and meet up with family. Instead, follow these guidelines and know that you can't feel, see, smell or taste radiation.

IF YOU ARE . . .

INDOORS
Close all windows and turn off heat, air conditioning and ventilation. Go to the basement, as far away as possible from doors and windows. Cover your nose and mouth with a mask or cloth.

OUTDOORS
Cover your mouth and nose. Remove your outer layer of clothing, avoiding pulling it over your head (cut or rip it if necessary). Find shelter quickly, and if possible rinse yourself with soap and water. Seek medical attention only if your wounds are life-threatening; avoiding further exposure is your biggest concern.

IN YOUR CAR
Pull over, turn off the ignition and shut any vents that draw in outside air, including your a/c. Cover your mouth and nose and monitor the situation on your car's radio.

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FIND THE STRONG ICE
Your best bet after falling through ice is to crawl out the way you came in—that's the ice that has already supported your weight.



ESCAPE FROM ICE

"People think that if you fall into ice water, you become hypothermic within minutes. This is incorrect," says University of Manitoba cold-water survival expert Dr. Gordon Giesbrecht, aka Professor Popsicle. "But if you think that, then you're likely to panic, make bad decisions and die." If you're the one left standing after a friend plunges through the ice, you should stay put. You won't be any help if you rush to the edge—and end up as a second casualty. If you have a rope or long branch within reach, you can use it to help pull your buddy to safety. Otherwise, you'll have to talk him through self-rescue. Help him calm down by instructing him to take slow, deep breaths, and let him know he is not in immediate peril (it takes about an hour to lose consciousness from hypothermia). Once he's calm, tell him to follow these steps:

1 • Place your forearms forward and flat on the ice edge, then kick your feet, which will create upward and forward bodily thrust.
2 • Keep kicking and move your weight forward onto your elbows as you shimmy your body up—inch by inch—in an Army crawl. Don't give up if the edge breaks: Just keep moving forward and repeating the motions until you reach solid ice.
3 • Once you're out of the water, don't stand up right away. Instead, roll away from the fissure until you're on thicker ice.

911 BASICS

Use a landline. Home phones provide operators with your address; cellphones do not. If you must use your cell, tell the operator your location immediately.

Stay on the line. Answer the operator's questions succinctly, and don't hang up until you're told to do so or help arrives.

Have a backup plan. Put local police and fire stations on speed dial.

If you suspect a poisoning, dial the National Poison Control Hotline at 800-222-1222, which will connect you with an expert for emergency advice. Call 911 only if a poisoning victim has passed out or is having a seizure or difficulty breathing.

Know when *not* to call 911. It's for real, life-threatening human emergencies. Cat up a tree? Call 411 or your town's general information line.

FIGHT A FIRE

More than 80 percent of the 2780 Americans who died in residential fires in 2008 were in one- or two-family homes—that's the bad news. The good news is that 99 percent of house fires are put out before they turn deadly. To stay on the good side of these statistics, stow fire extinguishers in your kitchen, shop and garage, and be sure every family member knows how to use them. If a fire is contained and the flames are no more than waist-high, fight it with an extinguisher. Keep your back to an unobstructed exit as you empty your canister, aiming at the base of the flames. Stop if breathing becomes difficult—most fire deaths result from smoke inhalation. If possible, close doors as you escape. And don't risk trying to fight the blaze with the garden hose: It spews about 20 gallons a minute, in which time a firefighter's nozzle blasts 250 gallons.



KNOW YOUR FIRE EXTINGUISHER Fire extinguishers are rated: A (wood, paper), B (flammable liquids), C (electrical) or D (lab chemicals). Home extinguishers should be rated for all but D.

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SAVE A DROWNING VICTIM

More than 3400 Americans drown in a typical year, several dozen of them while trying to save someone else. "Just because someone is a good swimmer does not mean they are capable of safely performing a rescue," says Bill Humphreys, who has performed about 1000 ocean saves in 34 years as a California lifeguard. "Even a professional doesn't just run out into the water; the first thing he does is call for backup." Then he grabs a rescue buoy or tube; for non-pros, a surfboard, a life jacket or anything else that floats will suffice. If you're the rescuer, swim out to the victim and hand over the flotation device without letting him grab you. "If you're a good swimmer, in flat water a small child is not going to take you under," Humphreys says. "But even teenagers, when they're panicked, will be fighting for their lives—and cling to and climb up on anything to get their head above water." If you put yourself within reach, that anything will be you. So let the victim get a hold of the piece of rescue equipment, then calm him down and begin paddling for land.

NOT AS SEEN ON TV

FLAILING DROWNING VICTIMS

"People waving for help, yelling and thrashing around in the water—that's what you see on television," Humphreys says. Actual drowning is much more subtle: "The head is low. He might even be looking upward a little bit in an attempt to keep his mouth out of the water. Quite often his arms aren't above water, because he's too busy trying to use them to stay afloat."

SURVIVE A BUILDING COLLAPSE

A fallen building, common after an earthquake, is extremely unstable. Whether you are trying to escape or free someone else from the wreckage, move carefully. If you find someone pinned under the rubble, first calm the person down—then start figuring out what you can use for leverage to free them. "Whatever's pinning them, you'll need to move it only 1 inch before you can slide them out," explains retired firefighter John O'Connell, who responded to both the Oklahoma City bombing and New York's Ground Zero and is president of the training facility Collapse Rescue Systems. "But you still have to be extremely aware, as you pry up on anything, so you don't disturb the pile and cause a secondary collapse. That's the biggest killer of rescuers." Time is also critical: If you don't free a badly injured victim in roughly the first hour, crush injury syndrome (kidney failure due to damaged muscle tissue in the bloodstream) comes into play. "If after 6 hours you free them and there's no medical aid, they're probably not going to survive," O'Connell says. Once you free your victim, keep him alert and give him water. If you're trapped in the structure, yell or bang on a pipe to alert rescuers, and be methodical. "If you just start smacking some crap around, they may think it's falling debris," O'Connell says.



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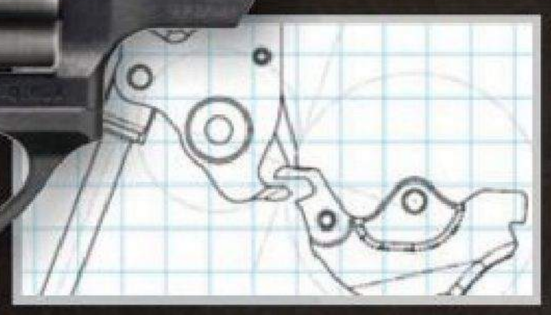
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HEADIN' OUT WEST

The 2011 Pop Mech Top Shop: The Adventure Continues

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ast month, we told you about the Popular Mechanics TopShop Project Mustang. We told you about the Victory motorcycle that went along with it, about how we charged a handful of small New Jersey shops with creating the ultimate weekend getaway package. The goal was a custom bike and car that would enable two people to take a killer weekend vacation without trading thrills for creature comforts.

In many ways, this project is a continuation of last year's TopShop program. Twelve months ago, we conducted a nationwide search for a shop capable of turning an stock 2010 Chevrolet Camaro into something special. The business we settled on, Netcong Auto Restorations, of Netcong, New Jersey, did just that. They cranked out a car that turned heads and shredded pavement everywhere we took it.

This year, we again subjected Netcong to our scrutiny and spotlight, but to keep things interesting, we upped the ante: We asked Grant Brazer, the 14-year-old son of Netcong's owners, to submit bodywork designs for the Ford. We purchased a trailer and engaged the services of Rollin' Fast Cycle Sports of Lebanon, New Jersey, to spice our bike up a bit. And we started planning a once-in-a-lifetime weekend trip that would take full advantage of both machines.

Through the magic of Photoshop, Grant produced a futuristic take on the Mustang's retro shape. He stretched the car's panels and character lines, tweaking and massaging them until the Ford gained an angry, next-generation vibe. Netcong turned his design into spectacular, candy-colored reality, and a host of chassis, brake and engine upgrades came along for the ride. A laundry list of creature-comfort interior modifications capped things off.

The motorcycle is the final piece of the puzzle. We chose the 2010 Victory Hammer S because it offers the look of an old-school cruiser and a hefty dose of contemporary technology. The Hammer's inverted front forks and dual-disc front brakes let it stop and turn like a modern heavyweight, and its 250-mm rear tire helps put the 97-hp V-twin's power to the ground. The only drawback is the bike's bare-bones nature—we wanted a bit more wind protection and comfort for our time on the road.

Enter Rollin' Fast. In addition to being a Victory dealer, Rollin' Fast specializes in custom motorcycle construction. We entrusted them with tweaking our Hammer into a more comfortable, more stylish piece, and they delivered. A Kicker stereo, fairing, candy paint, and a king-and-queen seat were matched with machined engine trim and LED accent lighting. We finished the project by having our small aluminum trailer painted Dupli-Color black. Then we headed west.



SPARK AS SCIENCE

AUTOLITE autolite.com

Autolite specializes in original-equipment-quality spark plugs, offering a suitable replacement for virtually every make and model of car ever produced. In designing plugs for new cars, the company's engineers consider a host of characteristics, including thread size, shell hex reach, installed height, heat range (determined using a special engine and test procedure under SAE standards) and more. All told, if it has an engine, Autolite probably makes a plug for it.

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The slanting walls of MGM's pyramid-shaped Luxor hotel are an imposing sight. Vegas's unusually cloudy skies only served to amp up the building's eerie, old-world vibe.

The goal of this project was to build something that had never been built before—a fast, comfortable convertible that could tackle both a once-in-a-lifetime vacation and long use on the open road. In our quest for the ultimate weekend getaway, we needed a car that would combine a compliant ride with practical amenities and a lack of compromises. Most of all, because we're speed junkies, we knew our car couldn't be a slug at stoplights.

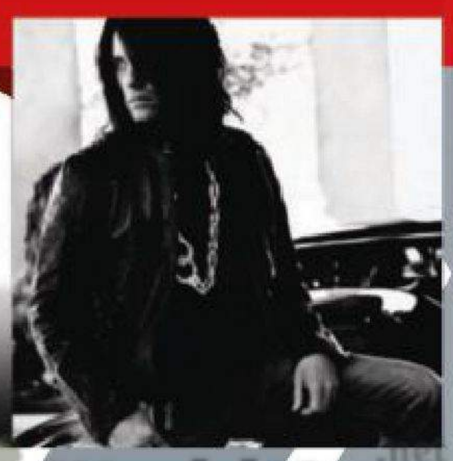
The 412-hp, V-8-powered Mustang GT convertible was perfect for the task. At just over $34,000, it's relatively inexpensive and can be bought by anyone with a full-time job. It's also relatively simple for a performance car, which means that anyone with common sense and a set of hand tools can modify it to make it faster and more capable. It keys into the Popular Mechanics DIY ethos. We went searching for a destination to fit, a do-it-yourself vacation spot that would let our custom stars breathe.

And so we went to Las Vegas. Nevada's most famous city is known as an adult Disneyland, but there's more to "Lost Wages" than, well, lost wages. Like the Ford, it's approachable and is relatively inexpensive to experience. The city is also surrounded by fantastic natural wonders. It's the traditional home of the extreme vacation—most people come here for the express purpose of having a very good time.

When we decided on Las Vegas, we chose a different path than most. This trip wouldn't focus on the world-famous Strip

A MAGICAL STAY

MGM RESORTS cirquedusoleil.com/believe



MGM Resorts International is one of the world's premier luxury lodging providers, and its Las Vegas outpost, the Luxor Resort & Casino, is a bright star in the company's firmament. The Luxor is currently featuring the talents of Criss Angel in CRISS ANGEL Believe, a 90-minute production showcasing some of the most spectacular illusions ever created. Angel, recently crowned Magician of the Century, uses an arsenal of magic feats to leave guests in a state of awe and frustration.

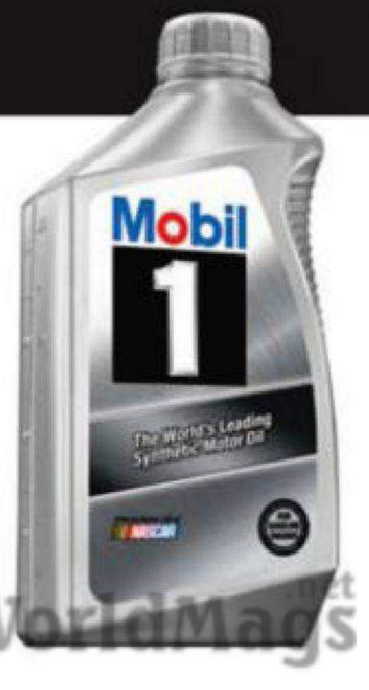
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The desert is a dirty place, and our trip west got the car and bike pretty filthy. A quick dash with Mothers California Gold Carnauba Wash and Wax and Back to Black Tire Shine did the trick.



and the star-filled bars therein. We'd start there, sure, but with only two days and two nights available, we wanted to spend our time wisely. We decided to leave the Strip as a base of operations, nothing more.

Our first stop was the MGM Luxor Resort & Casino. The Luxor's pyramid-shaped main building is an icon, but chiefly, the hotel fit with our theme: Like the Mustang, it offers good bang for the buck.

The Egyptian-themed Luxor is the second-largest hotel in Vegas, a massive, 4400-room monument to old-world excess. The hotel's architecture is fascinating—everyone loves a good gimmick, especially one with inclined elevators—but it's also conveniently located. Because the Luxor is close to the Strip's hot spots but not in the thick of traffic, it's easy to get in and out of. We hit town late in the day, the hotel's massive black peak guiding our way. The Mustang's red and yellow candy paint gleamed like the neon lights of Vegas.

About that paint: It didn't come easy. As Hal Haley, Netcong's most experienced body man tells it, "That finish was miserable. It was a blend of candy [sparkle] shades, and blending candies into candies is always difficult. The Camaro's paint took us four days; this took almost four weeks. Candies are never easy to lay down."

The details behind that statement are interesting, and worth a momentary detour. Because candies hold reflective materials in suspension, they require precise application and can be difficult to work with. With our car, the problem wasn't so much technique as what the Netcong crew was trying to accomplish: Most automotive paints are 70 percent pigment, 30 percent reducers and solvents, but candies are 70 percent solvent-reducer, 30 percent pigment. With such a high percentage of solvent, paint lifting is common, and blending—the art of merging one color into the next—becomes difficult.

All of this makes the end result that much more stunning. It's a seamless wash of ever-changing color, a work of art that glows and dances in the desert sun. According to Haley, Dupli-Color's paint formulations, offered under a brand known as Paint Shop, helped. The whole system is designed to be used right out of the can.

"I've done custom paint jobs that took six months of work," he says, "spraying over and over again until you get to a show-quality finish. Some go as much as a whole year if you're laying one color over the

Gumout Regane Fuel System Cleaner was added to keep our engine running clean amidst the harsh elements of the desert.



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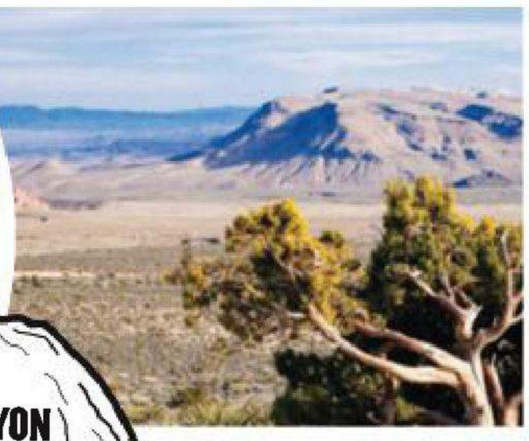
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next and the next. The Dupli-Color helped because it's a more user-friendly paint. It's premixed, and it has a very heavy pigment content that cuts down on blotching. Paint is never easy to lay because temperature and humidity changes everything, but the Dupli-Color system helped us immensely."

Performance Red, Chrome Yellow, Hugger Orange, and a mix of red and orange candies over a silver base: Under the desert sun, the Mustang's finish doesn't look like paint. It looks like magic.



After a quick cruise up and down the Strip, we settled into our room and began planning the first night. The first stop would be the Luxor's illusion show, a mystical, out-there experience put on by magician Criss Angel. Angel was recently named Magician of the Century by a panel of industry experts, and his Vegas show, a sense-defying experience dubbed Believe, is a must-see. Its illusions can't be described, but here's an effort anyway: A troupe of dancing bunnies. Disappearing everything. Legless wonder. And reformed skeptics.

We followed our stint at Believe with a glide into one of the Luxor's many bars. A leisurely walk around town followed, the hotel's massive rooftop spotlight (it's bright enough to be seen from space) guiding us home at the end of the night. After a quick check on the Mustang, safe and warm in the parking garage, we hit the hay.

The next morning offered one of those crisp western sunrises where the sky glows with color. The Ford burbled its way onto the highway, warming up and grumbling at the approaching dawn. Vegas sits in the middle of one of the nation's most amazing deserts, almost all of which is undisturbed and beautiful. Since we weren't gifted with a lot of time, we wanted to see that beauty first-hand. We cranked the taps on the 5.0-liter, the BBK headers and Borla exhaust singing, and roared off to the west.

The highway revealed a few things about the Mustang's personality. As project cars go, our goals with the Ford were unique: When we briefed Netcong on the project, we asked for speed with comfort and flash with style. Those are seemingly conflicting goals, but we didn't want to put the spotlight on an easy job. We wanted to see our shops respond to a challenge.

The end result was impressive. The Mustang's suspension, a carefully selected combination of aggressive Cooper Zeon RS3-A tires, Bilstein shocks, lowering springs and Steeda heavy-duty sway bars, offers a well-rounded alternative to the typical one-trick-pony chassis. It's firm without being harsh, capable but compliant. Combined with our relatively stock engine—an AEM cold-air intake,

TOP SHOP

TIP No 04★★

When installing expensive halogen or high-intensity-discharge headlamps, resist the urge to touch the surface of the bulb. When the bulb heats up, the oils from your fingers will cause a hot spot that could lead to bursting. If you accidentally touch it, clean it with a blend of rubbing alcohol and water.

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The Cooper Zeon RS3 is specially designed to accentuate the high horsepower and extreme handling capabilities of today's muscle cars, so it made perfect sense on our 412-hp Mustang. The RS3-A all-season uses tread compounds and grooving technology that put a premium on wet-weather traction, while the RS3-S summer tire emphasizes crisp handling and confidence-inspiring high-speed ability. We wanted a balance between style, comfort and handling, so we chose the 18-inch RS3-A. It wasn't a mistake.

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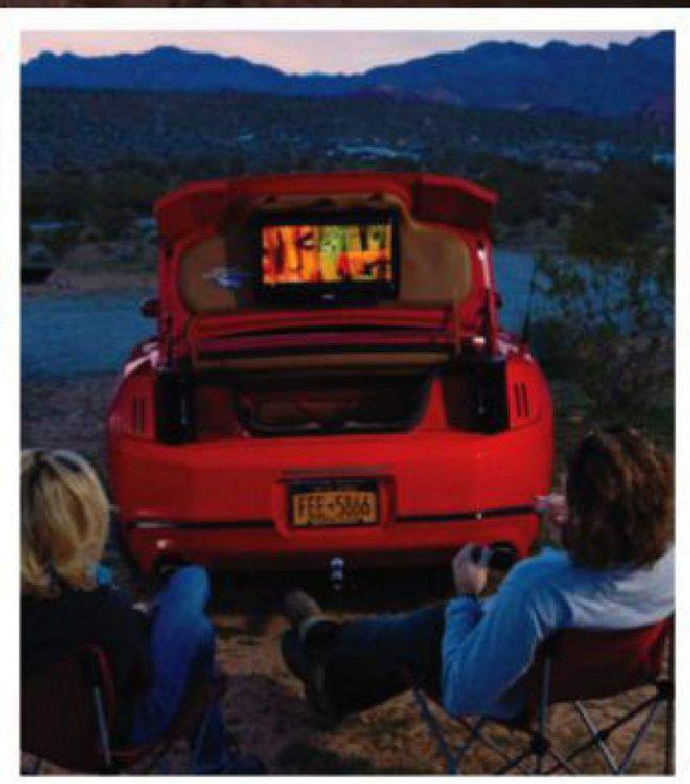
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Autolite spark plugs, and a mild fuel-injection retune were chosen in the interest of good fuel economy; Mobil 1 Extended Performance oil and Gumout's Regane Fuel System Cleaner were chosen to maximize performance in tough conditions—the suspension changes make for a long-legged machine that can still burn rubber when necessary. Tickle the throttle with your right foot, the Ford leaps forward. Dive into a corner, and the suspension takes a reassuring, early set, even with a trailer attached. The miles disappeared.

Our first stop was Red Rock Canyon National Conservation Area, just off state highway 159 on the west side of town. Red Rock is fifteen minutes from downtown Vegas, but given what it looks like, it may as well be on the far side of the moon. The area's 195,000 acres encompass some of the finest scenery in the west. Knobby mountains jut out of the horizon, creosote forming a thick and brushy carpet on the desert floor. The long, slow march of prehistory is painted across the jagged canyon walls like so much universal graffiti.

Calling Red Rock a nature lover's paradise might be an understatement. Aztec sandstone peaks hide countless hiking and climbing trails, off-road driving areas and epic waterfalls. We slid the Mustang to a halt and set up camp in a clean government campground on a nearby plateau. Campsite prices vary, but figure on no more than $15 or so for a decent spot. Despite a laid-back feel, the campground claims to have served over 500,000 people since 1999. Our spot, on a deserted hill in the back, felt wonderfully remote.



The Mustang's trunk lid houses a Vizio monitor, a Playstation 3, and a host of camping accessories. As the sun set, we cracked a few beverages and relaxed by the screen's light.

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Naturalist John Muir once said that, by tugging on any single thing in nature, you can find it attached to the rest of the world. Those poignant words are etched into a wall at the Red Rock visitor's center, and they reminded us that road trips encompass more than just highways. Convertible or no, we needed to get closer to the scenery. After scouting the area, we unloaded the Victory.

Red Rock is easily accessible by car, but it's best seen—and smelled, and felt—by motorcycle. The Hammer's lumpy, basso exhaust note punched through the desert air easily, ripping out across the countryside and echoing through the hills. Rollin' Fast delivered an excellent piece: The Hammer's Dupli-Color paint, color-matched to the Mustang, was paired with a full fairing, a custom Kicker stereo, and color-matched hard saddlebags. The bags hold the stereo's amplifier, and a custom-built king-and-queen seat turns the Hammer into a machine suitable for two.

We spent the afternoon leisurely cruising through the area while contemplating our next move. It proved to be a relaxed evening and a starlit dinner at our campground. It was then that we took a hard look at our Mustang's interior.

Creative Auto Interiors of Butler, New Jersey does a lot of work for luxury-car dealers in the New York area, but their passion is interior design. We gave them a free hand with the Ford, delivering an empty shell without a convertible top. As we mentioned last month, Rodger Pisani, Creative's main brain, loves a challenge. He took to the car like a duck to water, chalking out designs on bare fabric and dreaming up ways to make it more comfortable on the road.

The combination that resulted is as attractive as it is intense. The factory dash and door panels have been covered with crocodile-pattern red inserts, the remaining interior plastics spray-dyed to match. Custom red carpeting is matched

TOP SHOP

TIP №05★★

When insuring your motorcycle, don't discount the value of things like accessories, custom parts, and add-ons. Progressive provides at least $3000 of accessory coverage when you purchase motorcycle comprehensive or collision coverage. Up to $30,000 is available as an add-on. In the end, it's better to be safe—and know your bike is covered head-to-toe—than sorry.

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Custom car-building takes serious tools, and our project Mustang was no exception. We chose Stanley Tools for its lineup of adaptable, easy-to-use, durable hand and power tools, and it was a choice we didn't regret. The finishing touch to our project was a custom Stanley toolbox, emblazoned with the Pop Mech Top Shop logo, that fits neatly into the Ford's trunk. Stanley specializes in unique automotive solutions for real car people—our box is practical, tough, and more than up to the rigors of the road.

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ELDORADO CANYON MINE TOURS

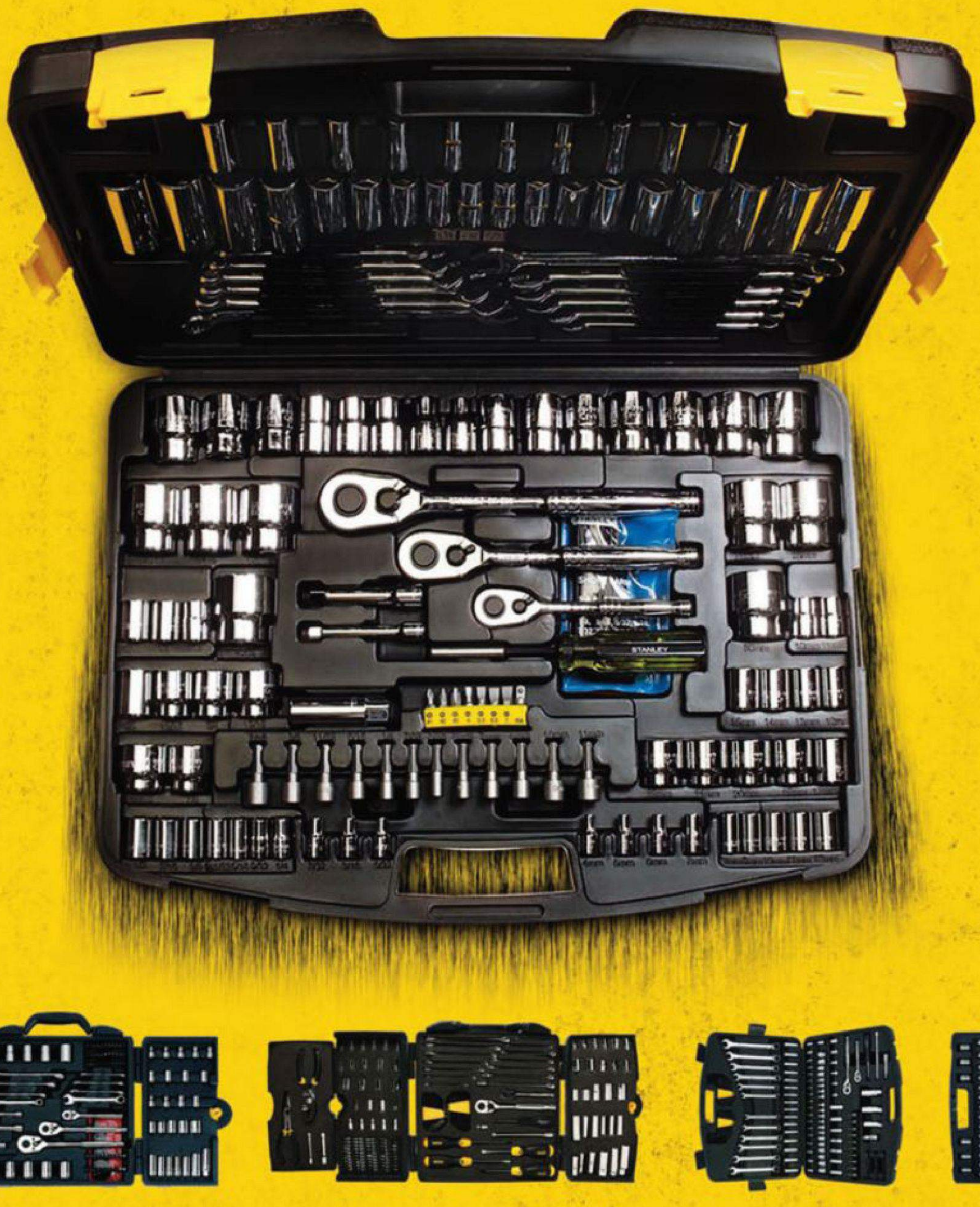
Eldorado Canyon Mine Tours, just outside of Nelson, Nevada, is a veritable candy store of antiques and ghostly buildings. It's easily accessible by car and just an hour outside of Vegas.







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«« Our Mustang's interior was completely reupholstered. It includes custom-paneled seats and a video monitor built into the dash. The 5.0-liter V-8 under the hood received upgrades including an AEM Cold Air Induction System.

to repaneled, recovered tan seats; the latter offers a more cohesive appearance than the stock seats while remaining comfortable. A video monitor and navigation system is integrated into the dash, replacing the center A/C vents, and glossy tigerwood veneer brightens up the interior's flat surfaces. A custom LED shift knob lights up according to what gear the six-speed transmission is in, and a Kicker upgrade system—a plug-and-play solution that includes everything from connectors to speakers—is hidden throughout the interior. There's also a trunk-mounted subwoofer.

Still, the best part is behind the two front seats. Pisani yanked the Ford's rear bench and seatbelt-anchor towers, installing a custom-built bulkhead that houses a microwave, a small coffeemaker, a cooler, and a storage bin for camping gear. As he tells it, the idea was to create a mobile campsite so you wouldn't have to stop for things like coffee on the road. It makes sense, it's practical, and it works.

Naturally, Pisani couldn't stop there. The Mustang's trunk is a treasure trove of goodies, from the 22-inch Vizio LCD monitor in the lid to the Sony Playstation 3 and wireless speaker system hidden in the rest of the compartment. Custom folding chairs, upholstered to match the seats, live there; a Stanley custom toolbox fits between the wheel wells.

There's also storage for a portable grill, a tent and a DirecTV receiver.

Suitably overwhelmed, we spent the rest of the night chilling out by the light of the Ford's trunk-mounted video system. Who says camping has to be rustic?

The next morning saw the Hammer S back on the trailer and our party restless. Our female traveler wanted to see the human half of Nevada's history, and so we left our



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The Ford's seat pattern mirrors that of the stock car but has been tweaked for a more pleasing appearance. The rear-seat console holds a coffeemaker and microwave.



Rodger Pisani and his crew integrated a Playstation 3, stereo subwoofer, and Stanley custom storage unit into the trunk's capacious depths.

campsite at full bore, circling around to the city's east side on little-traveled state highways. Most of the land was barren, and once we left the city limits, few other cars were seen. No speed limits were broken, because that would be wrong. (That's our story, and we're sticking to it.)

Nearing Hoover Dam, we ran smack into state highway 95, which pops out of the south side of Henderson, Nevada, and beelines for the California border. It's a great place to test a car's legs, but that wasn't what we were after. We took the first major side road we came across, which happened to be state route 165 toward Nelson, Nevada. The road quickly grew twisty, but the Victory was strapped down tight, so we went for it.

Most of southern Nevada is protected government land, dutifully overseen by the Bureau of Land Management. There are pockets of citizen space here and there, but if you find a privately owned house, it's likely owned by the government and leased out long-term. The juxtaposition of natural canvas and private construction is an odd one, especially in Nelson.

Nelson is a dried-up mining town that was a once-thriving village. But two minutes past its limits on 165 lies Eldorado Canyon Mine Tours, a rambling, family-run business set in the world's most charming scrap yard. Eldorado Canyon is built around a dead—not tapped out, just unsafe—gold and silver mine from the 1860s, and the company's chief offering is an in-depth look at the blood and guts that built the American West.

Bobbie Werly owns the business with her husband, Tony. They moved to Nelson from the Las Vegas suburbs 17 years ago, purchasing the mine as a base for kayak tours on the nearby Colorado

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River. After digging out the mine's entrance with their children, they tapped into a rich vein of the area's history—the original shafts were still present, as was much of the area's legacy. Modern tours run hundreds of feet deep into the earth and let tourists experience an authentic part of the Old West. Years of research and investigation, however, reminded the Werlys that history isn't always pretty.

"Over two dozen murders happened on these grounds in the 1800s," Bobbie says. "The mine brought hundreds of people to the area, and the house we're living in used to be the miners' commissary. This was Indian territory, a land of claim jumping and bloodshed. It was a bad place."

Like most abandoned mines, the



Werlys' property is spooky and intriguing. It's also charmingly ramshackle. A massive antiques collection dots the grounds; ancient Chevrolets and engineless Willys trucks fill the gaps between buildings. The Mustang's exhaust echoed off sun-dried wood and century-old mining equipment. The government land in the background, thousands of acres of unspoiled glory, begged us to sit and gawp.

But the Mustang burbled, its candy paint flickering in the sunlight. The Victory suddenly seemed nervous and cooped up on the trailer. It was time to go, so we climbed back on the road.

As the day creeped into afternoon, the

If you had a fast car, a faster motorcycle, and an open dry lakebed, would you go tearing across the scenery at warp speed? We did, too.



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Keeping a car clean is a catch-22—if you drive it, it's going to get dirty. If you don't drive it, it'll stay spotless, but where's the fun in that? Mothers cleaning products take the work out of car detailing. The company's Back to Black Tire Shine offers a high-gloss finish with outstanding durability, and its California Gold Carnauba Wash and Wax provides a quick, easy way to restore your paint's gleam. Both leave that "just washed" look on long enough to keep you racking up the miles.

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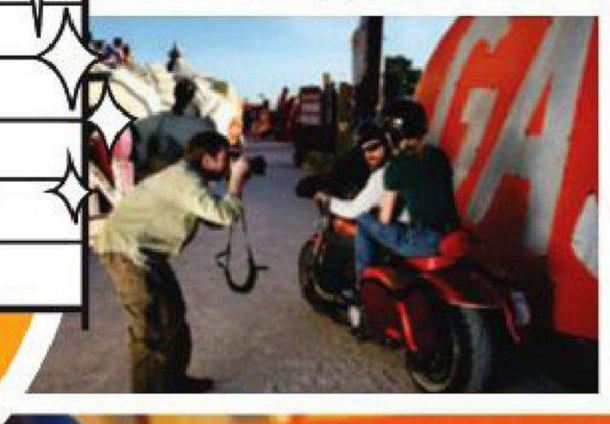
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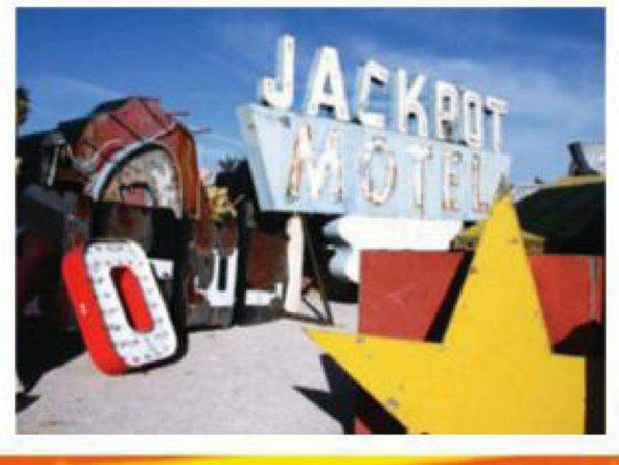
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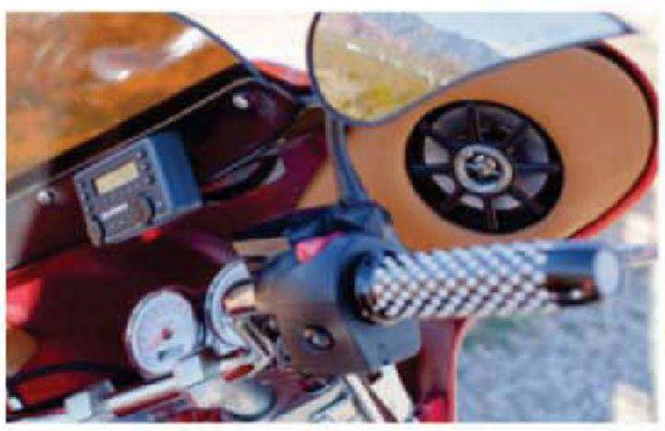
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Our Victory Hammer's custom Kicker stereo and large fairing made highway travel a breeze.



ride back to Vegas seemed too short. A dry lakebed appeared on the left, and we impulsively turned onto it. The Victory found its way off the trailer, its wakened V-twin coughing and stirring up sticky plumes of dust. Our female traveler fired up the Mustang, cranking the Kicker stereo through the roof. After a quick check to make sure the engine's flood levels were stable, she dumped the clutch, tearing off toward the horizon. Fifteen minutes later, after running the Hammer at full tilt across a slick lakebed and living to tell the tale, we dropped a boot and came to a halt.

Bike: surprisingly stable and quiet at speed. Mustang: surprisingly loud and raunchy. Both vehicles: filthy. And we didn't have a care in the world. It helped that both the Ford and motorcycle were covered by policies from Progressive Insurance. We had no qualms about using either vehicle the way its designers intended. Except for the dirt all over everything.

Luckily, we had the foresight to stash a bag of Mothers polishes, cleaners and waxes in the Ford's trunk. After cleaning the car at a nearby truck stop, we took a leisurely return to Las Vegas.

The last stop on our trip came about purely by accident—wanting to escape the Strip and see more of Vegas's old-world history, we took advantage of the waning light and hit up the city's historic north side. It's there that we stumbled onto the world-famous Neon Museum.

Las Vegas is notoriously cannibalistic, consuming businesses and people that can't hack it in the city's harsh economy. Hotels come and go on a regular basis, and there are few remnants of the town's early gambling history. The Neon Museum is a 501(c)(3) non-profit organization dedicated to preserving that history. It's a treasure trove of more than 150 full-size neon and incandescent signs from the 1950s, '60s, and '70s. The names there are fascinating, a frozen directory of iconic places like the Stardust and Golden Nugget. You walk among giants, rusted steel and faded paint watching your every footstep. It's a hard place to visit—the turnover and march of

TOP SHOP

TIP No 06 ★★

No one likes cleaning up, but when it comes to tools, an ounce of prevention is worth a pound of cure. Wiping your tools down after use helps remove corrosion-inducing moisture and prevent dirt from fouling moving parts. Modern tools are almost indestructible, but every little bit helps.

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progress is more than a little sad—and an even harder place to leave.

But leave we did. Thoroughly worn out, we headed back to our campsite at Red Rock and collapsed. As the sun set over the hills, we prepped for the trip home with a cup of coffee, grilled food, and a movie on the in-trunk Playstation. A Cooper Might-D-Light folding LED work light, thoughtfully left in the trunk by the guys at Netcong, helped illuminate the evening. Exhausted and ready to return to real life, we finally clicked the light off and settled in under the moonlight, the Ford's exhaust ticking as it cooled.

All in all, we packed a lot into a short amount of time, and our shops built the perfect two vehicles to do it with. "Ultimate" is a loaded word, and getaways are what you make them, but as weekends go, it doesn't get much better than this.

Like what you see and want more? Check out *pmtopshop.com* for extended project coverage, in-depth videos of the build, the trip and other cool extras.

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Drivers Ed

THE PRICE OF FINISH NAILERS IS DROPPING WHILE THEIR BENEFITS ARE INCREASING. WE TEST 10 TO LEARN WHICH IS THE SLICKEST SHOOTER.

BY ROY BERENDSOHN

Why use a pneumatic finish nailer when a hammer will do? Speed. A pneumatic nailer allows you to position a workpiece with one hand and fire a finish nail into it with the other. Pros love the way these tools can speed a job along, but the DIY crowd likes them, too. To a time-starved homeowner racing to complete a project, a finish nailer can mean getting it done that weekend rather than seeing the work drag on and on. We gathered 10 of the newest 15-gauge nailers—tools that can fire a nail up to 2½ inches long in the blink of an eye. Better still, they drive a nail without need of a pilot hole and pose little risk of splitting the wood. We tested them in every common building material—including a 3-inch-thick red oak block. All the tools drove a nail with a vengeance, but the best were easy to use, incorporating features like a worklight or a belt hook. And if the occasional nail jammed in the nose, it was easy to clear. Here's what we found.

INSIDE × POWER WASHING + HOW TO BUILD A GO-KART + DEALING WITH RUNOFF

STUDIO D

PHOTOGRAPH BY **PHILIP FRIEDMAN**

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15-GAUGE NAIL GUNS



Best Overall









Rating

BOSCH
FNA250-15

PRICE: $450
WEIGHT: 4.1 pounds
NAIL SIZE: 1¼"–2½"

Likes: The Bosch is easy to load and easy to handle. It's a well-balanced tool, and the rubberized handle ensures a good grip, no small benefit when you're hunched down nailing trim or standing on a ladder firing into crown molding. And the drive-depth adjustment is simple: a ridged cylinder near the nose that you turn.

Dislikes: When it came time to drive the 2½-inch-long fasteners into red oak, we found that the gun did not countersink them as reliably as the other nailers. The spring-loaded mechanism to clear jammed nails from the nose is a ridiculously stiff contraption.

BOSTITCH
N62FNB

PRICE: $180
WEIGHT: 4.1 pounds
NAIL SIZE: 1¼"–2½"

Likes: This tool defines what a finish nailer can be through excellent industrial design and nail-driving punch. The LED worklight is convenient, varied nose tips suit most molding profiles, and a pushbutton air nozzle clears the workpiece of dirt and debris. The designers included a fold-out hook that, combined with the gun's length, marks out 16-inch centers. It was the only nailer to have done away with the rotating exhaust port. Instead, it routes exhaust through a baffle at the rear of the handle, keeping the air clear of your face.

Dislikes: Nothing noted.

CAMPBELL HAUSFELD
CHN70600

PRICE: $147
WEIGHT: 5.5 pounds
NAIL SIZE: 1"–2½"

Likes: A finish nailer should be easy to load and fire, and be able to clear the occasional jammed nail. The CH nailer succeeds on all counts—and you have to wonder why more expensive products don't have features like its clearly marked pushbutton that switches the tool back and forth from sequential to bump fire. We also appreciated the CH's low-nail indicator light.

Dislikes: We found that the tool's onboard stud finder didn't work reliably enough to be of real benefit. We also don't see the need for a laser pointer, and the rubber nosepiece, held to the tool with a tether, is clumsy.

CENTRAL PNEUMATIC
97554/94440

PRICE: $80
WEIGHT: 4.8 pounds
NAIL SIZE: 1¼"–2½"

Likes: If you've been holding back on purchasing a finish nailer because of price, wait no longer. I'll admit we looked askance at this budget-priced tool—until we loaded it with 2½-inch nails and fired one after another into our red oak test block. Ninety percent of the nails were perfectly countersunk to a depth that would accept putty. The tool is so simple, there's really not much else to say.

Dislikes: Yes, this tool is inexpensive, but its spring-loaded latch for clearing jammed nails is so unyielding, we wish the manufacturer had invested a few extra design dollars to improve it.

CRAFTSMAN
351.181770

PRICE: $150
WEIGHT: 4.4 pounds
NAIL SIZE: 1¼"–2½"

Likes: If there's one thing that we've learned from testing tools over the past 20 years, it's that basic is good. Too often, manufacturers fumble the design ball when they start adding features. Not Craftsman. This nailer has been shorn of unnecessary elements—it's just happy to drive a nail of any size into any material. We particularly appreciated the flip-open nose compartment: Clearing stuck nails takes only a moment.

Dislikes: We're nit-picking here, but the adjustable exhaust deflector is slippery, and the depth-adjustment wheel needs to be larger.

PHOTOGRAPHS BY **STUART TYSON**

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DEWALT
D51276

PRICE: $190
WEIGHT: 3.9 pounds
NAIL SIZE: 1"–2½"

Likes: We've come to respect DeWalt tools in our tests. They're a sturdy, reliable breed. So it is with this feather-weight product. It loads and unloads easily, and it packs a punch. We also appreciate the common-sense graphic by the trigger that spells out which way to turn the drive-depth adjustment; that saved us some fiddling as we moved from one task to the next.
Dislikes: We didn't much care for the trigger—you have to change it to convert from sequential to bump fire. The spring-loaded latch to clear jammed nails is painfully stiff.

HITACHI
NT65MA4

PRICE: $160
WEIGHT: 4.2 pounds
NAIL SIZE: 1¼"–2½"

Likes: Power tools should be equipped with useful features, not bells and whistles, as the Hitachi successfully shows. Press the button at the tool's back to activate the blow nozzle and sweep the workpiece clean with a burst of compressed air. A simple and comfortable spring-loaded lever toggles the tool back and forth from sequential to bump fire, and the exhaust port at the back of the tool is easy to turn to direct the flow away from your face.
Dislikes: The Hitachi is among those tools with an awkward lever-activated latch for clearing jammed nails.

PORTER-CABLE
DA250C

PRICE: $170
WEIGHT: 3.9 pounds
NAIL SIZE: 1"–2½"

Likes: Lightweight, solid, uncomplicated—that's the Porter-Cable nailer. You can easily spin its exhaust air vent to direct the air out of the way, and the plastic magazine is so slippery that the nails slide in and out as if the contact surfaces were covered in ice.
Dislikes: "Downright annoying" is how one tester described the sharp-edged belt hook, which is too long and catches on your hand. We also didn't care for the fact that you have to swap the trigger to convert the tool to bump fire; it just seems unnecessary.

RIDGID
R250AFA

PRICE: $180
WEIGHT: 4.2 pounds
NAIL SIZE: 1"–2½"

Likes: One thing our tests have revealed about Ridgid tools is that they tend to be fast-handling. In this case, the molded grip on the Ridgid is slip-resistant, and in cross section it's wider at the back than it is at the front. Those features combine with the tool's light weight and good balance to make it quick on the draw. We also liked the nice, big thumb latch on the nail pusher. It certainly makes loading nails easier.
Dislikes: Why the designer overlooked the latch to clear jammed nails we don't know. It's resistant and clunky.

SENCO
FINISHPRO 42XP

PRICE: $250
WEIGHT: 4.7 pounds
NAIL SIZE: 1¼"–2½"

Likes: The Senco is a finish nailer of the old school, with heavy, robust construction and a hearty *kerthunk* sound as it perfectly countersinks one nail after another into red oak. Of all the tools equipped with a spring-loaded latch to clear jammed nails, it was the only one that could be easily flipped open and closed. We also appreciated the rugged nail magazine, for those times when you reach down and pick up the tool by that, not the handle.
Dislikes: We prefer a simple button or latch to switch the tool from sequential to bump fire. The Senco requires you to change the trigger.

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Homeowners Clinic

by Roy Berendsohn

Q+A



Q Power-Washing Basics

Either I'm doing something wrong or my electric pressure washer doesn't cut it. I pressure-wash my house every summer to remove dirt and mildew, but the results are less than sparkling. Can you tell me how to do this so I'm not wasting my time?

A Until they gain some experience with a pressure washer, homeowners tend to look upon one of these machines as if it were a magic wand. Wave it over your house, car, truck, boat or tractor and, presto, it's clean. As usual, the truth is a bit more complicated and subtle than that.

Pressure washers do live up to their billing in that they are incredibly productive and water-conserving. But as with any other piece of outdoor power equipment, you have to select the right machine, then use it correctly.

First, unless you have a very small house (or a house that's not particularly dirty), it's likely that an electric machine is not powerful enough to do the job. These machines are better suited to cleaning cars, small boats and patio furniture. Pressure-washer capacity is measured in cleaning units—the product of water pressure (in psi, or pounds per square inch) multiplied by flow rate (in gpm, or gallons per minute). An electric pressure washer may operate at 2400 cleaning units; a homeowner-grade gas engine model can get up to 6210 cleaning units, and professional machines can hit 16,000 cleaning units (4000 psi and 4 gpm). Cleaning units translate directly into effectiveness.

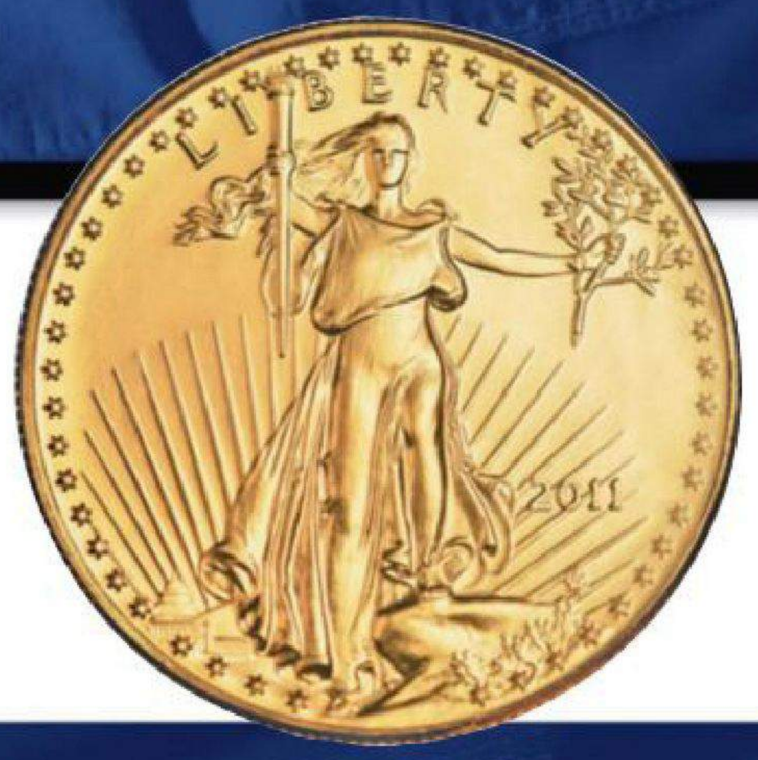
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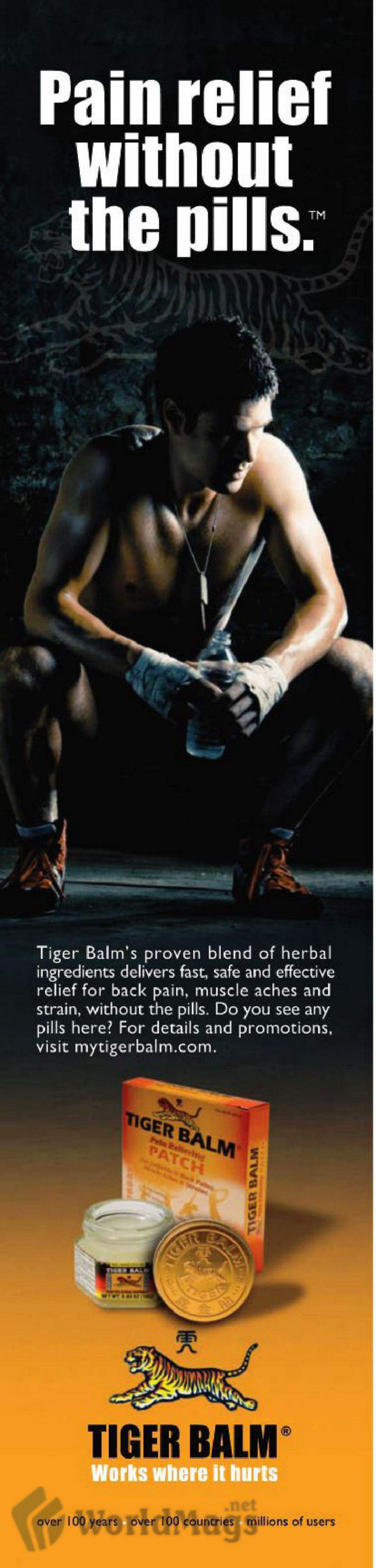
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DIY SAFETY

CLEAN IS GOOD, INJURY BAD

Take steps to avoid injury and damage while pressure washing.

WATER AND ELECTRICITY DON'T MIX

You're going to get wet when pressure washing, and that puts you at risk of receiving an electrical shock from wires and exterior outlets. Look overhead to check for power lines before placing or extending ladders. Avoid blasting the house's electrical service-entrance cable, the electrical meter, exterior outlets and exterior lights.

STAND FIRM

Position the ladder on a firm footing at the proper angle (about 75 to 78 degrees). To assess the angle, place the toe of your boot against the ladder's base. With your arms straight out, you should be able to rest your hands on the rung in front of you (usually the fifth rung).

Obviously, the most dangerous part of this work is operating a pressure washer with two hands while standing on a ladder. If you're at all uncomfortable with ladder work, hire a professional. Otherwise, take your time, lean against the ladder, and stop if you feel uneasy.

DO NO HARM

Try a pressure nozzle with a wider fan pattern before resorting to one with a narrower pattern. Yellow nozzles spray at a fan pattern of 15 degrees, green at 25 degrees, and white at 40 degrees. Reserve the red nozzle (0 degrees) for unusual applications like stripping off hardened mud. Keep the nozzle moving, and hold it the recommended distance from the surface. Finally, avoid blasting water upward at a steep angle under siding. Also, don't blast directly into corners, under the edge of windows and doors or into dryer or attic vents.

+ WHAT TOOLS I NEED NEED



Aside from a pressure washer [A], you need other gear. Mix cleaning solutions in 5-gallon buckets [B]. House wash [C] is a cleaner formulated specifically for pressure washers. Reserve general household cleaners and chemicals for cleaning by hand; bleach, for example, can damage a pressure washer's pump. Mix Jomax mildewcide, bleach [D] and water for treating severe mildew. Pour the mildewcide solution into a pump garden sprayer [E] and apply it, scrub and rinse. Work with a fiberglass extension pole and soft siding brush [F] to scrub anything that can't be sprayed, such as louvered dryer vents. Don't guess: Use a measuring cup [G] to mix cleaners. Use a stiff deck brush [H] for tough scrubbing jobs.

So, let's say you spring for a gas engine machine. Will that solve your problems? It's likely to help, but I wouldn't count on the machine alone to do a really thorough job. I find that I get the best results when I use a pressure washer in conjunction with hand tools.

If the mildew is not severe, pressure washing alone will do the trick. But if it's bad, I pretreat the mildew-stained areas using nothing more than a pump garden sprayer loaded with a solution of liquid bleach, Jomax mildewcide and water. I spray this on, scrub, rinse and then pressure-wash with a multipurpose siding cleaner. It leaves an immaculate, streak-free surface. And when I use the pressure washer, I've had better results washing from the bottom up and rinsing from the top down (see "Clean Is Good, Injury Bad"). Professional contractors—who move a lot faster than I do and often work in squads—wash and rinse from the top down. Since I'm not a professional, my goal is to take my time, work safely and get the house clean enough so that it won't need to be done again for at least another year, and maybe longer.

Bug House

Our house and yard became infested last spring with bugs. (We call them stink bugs, but I'm not sure what their real name is.) They stayed with us all summer and came inside in the fall. It was awful. Please tell me how I can prevent this from happening again.

Bugs are on the march. Bedbugs are infesting cities, emerald ash borers are decimating trees in the Great Lakes region, and cutworms are laying waste to crops in the Corn Belt. And don't even get me started on deer ticks. I came back from a chain saw test last spring with one that took a doctor and a scalpel to remove.

And then there are the stink bugs you mention. Taking their name from the bad smell they emit when crushed, these shield-shaped bugs are not a single type, but a group. They've populated the mid-Atlantic region and are moving west. Urban myths are already circulating. No, their odor does not attract other stink bugs, and although some types arrived from Asia, others are North American natives.

They're a tough adversary at the residential level and agriculturally. Worse, they're resistant to many pesticides, according to George Hamilton, professor of entomology at New Jersey's Rutgers University, who studies the bugs. "You spray them [with insecticide], they look like they're dead, and then they come back in 48 hours," he says.

Rather than blanketing your house and grounds with insecticide, Hamilton recommends first doing everything you can to seal up entry points. Many homeowners have found the bugs pouring in through window air conditioners. These appliances are often inadequately sealed to the window opening, and the bugs often manage to enter through the machine itself. You can use weatherstripping to seal around the appliance, but there's not much you can do to prevent the bugs from coming right through it.

Other entry points are torn window screens and the space beneath damaged weatherstripping on the bottom edge of doors and windows. These insects can also squirm through gaps in siding or trim and the openings around electrical boxes or hose bibs that are mounted to the siding.

You can use a variety of materials to seal these openings: Thum-Gum (a weather-resistant putty popular with electricians and telecommunications technicians), caulk and spray foam sealant applied inside the house.

If you have to turn to pesticides as a last resort, Hamilton and his colleagues have found a handful of outdoor sprays to be effective. Use products containing B-cyfluthrin, cyfluthrin, deltamethrin and A-cyhalothrin.

Runaway Runoff

Where we live in Florida, water runs down through the backyard and along and under the driveway. Then it comes out at the front of the house, under a sidewalk. How do we stop this runoff, and how do we plug the undermined areas beneath the walk and driveway to keep them from collapsing?

That's pretty serious runoff. When it's that bad, you need a multilayered

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approach. If this is a recent phenomenon, check that the runoff is not coming from nearby construction (say, a parking lot that's at a higher elevation than your yard). If you find this, notify the town.

That brings me to the multilayered solution, which involves some earth-moving and landscaping. Before you begin this work, though, notify the state's One Call excavation alert system. Utility-marking companies will then come out and identify where underground utilities cross or enter your property. The last thing you need is to hit an underground gas line with a rented backhoe.

When dealing with runoff, remember the acronym DIG, which stands for "divert, intercept, grade."

DIVERT: Berms (small ridges) and swales (small, shallow ditches) can direct surface water away from a house or paved surface. Both can be gracefully shaped to steer water where it needs to go, and both can be planted to blend into the landscape and improve their ability to absorb water.

INTERCEPT: French drains (essentially gravel-filled trenches with perforated pipes at the bottom) can absorb surface water and allow it to percolate into the ground; dry wells can do the same for water discharging from downspouts.

GRADE: Broad areas need to be contoured so that the house sits on high ground and surface water can move around it.

While you're doing this corrective landscaping, consider putting in a rain garden, a landscaped area planted specifically to absorb runoff.

After getting the runoff under control, contact a grout-pumping or slab-jacking company to see if it can fill the undermined areas below the driveway and sidewalk.

Sinister Bend

We just had a standby generator installed. The contractor connected the gas line to the generator with a flexible hose that has a sharp bend. The hose isn't kinked, but it looks suspicious. When I spoke to him about my concerns, he said that the gas hose is flexible, so it can make a bend like that. Should I be concerned?

Yes. A change in the gas line's direction is supposed to be accomplished with steel elbows, not by bending the flexible gas line—which is flexible only for the purpose of absorbing vibration. The generator's installation instructions probably spell this out. Report the problem to the manufacturer, ask for the installation instructions, present these to the contractor, and request that he redo the connection.

Dirty Dishwasher

Our house has hard water that is clogging and ruining our dishwasher. We're on our second dishwasher in five years. Often the dishes are barely clean or need to be washed again. We don't want to install a whole-house water softener. Is there another solution?

If you're worried about introducing salt into the home's water, connect the water softener to the water heater only. This will prolong the life of both the water heater and the appliances downstream from it, such as your dishwasher. It will also solve the problem of introducing softened water to the house's entire water supply, including drinking water. If you don't want to install a water softener because it takes up too much space, there are compact water softeners, some of them not much bigger than a large wastebasket.

Off the Wall

I live in an old house, and I applied one of those basement-wall coatings to my brick foundation. At first, it really made the basement look good, but now it's peeling like crazy. This is more than I bargained for. Should I scrape it off and start all over?

No. Let the coating peel off, or assist it with some stripper. Then leave well enough alone.

Old brick-and-mortar foundations are lousy surfaces to receive a coating. Their walls wick moisture from adjacent soil, as do their footings from the ground below (a condition called rising damp). Then there's a century's worth of mineral salts, mildew, coal dust (and goodness knows what else) sticking to the

brick. All conspire to keep even the best coating from properly adhering.

Tattered Threads

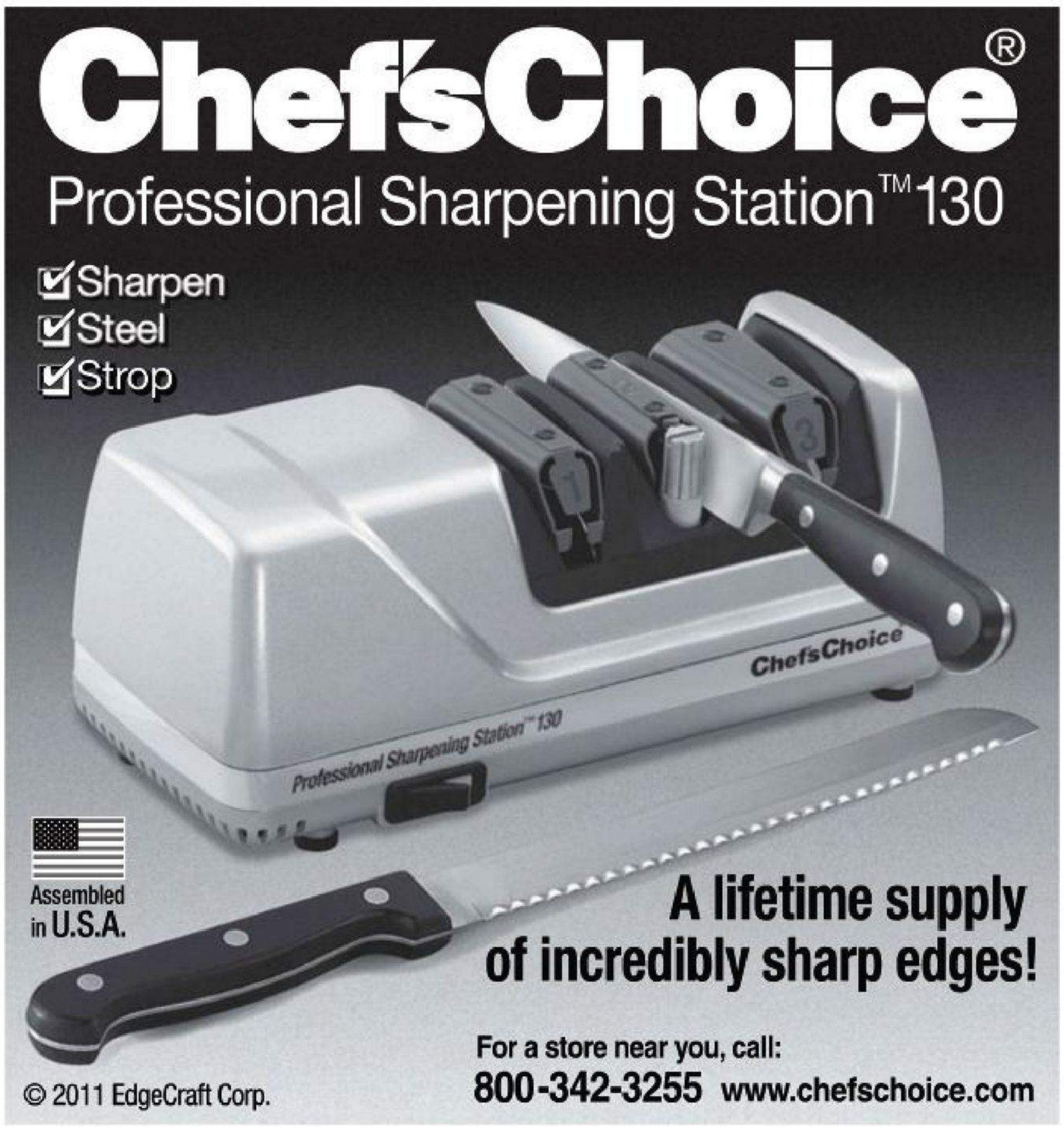
I was working on a small electrical project a few weeks ago, and the screws that came with the light fixture were too long. They kept bumping into wires in the box. I tried to cut the screws shorter with a hacksaw, and it drove me nuts. I ruined the screws and had to drive back to the hardware store to get shorter ones. How do you cut screws to length, especially such small ones?

Small screws are best cut to length with an electrician's wire-stripping tool. The better varieties of these tools have an arc-shaped series of holes just below their jaws. You'll see that the holes are designated by common electrical screw sizes: 10-24, 4-40 and so forth. Thread the screw into the hole, then shear it to the correct length.

Thread the screw back and forth through the cutting hole a couple of times to smooth any rough edges. Each hole also functions as a thread-repair die. You can use it to clean up a small screw that is a little rusty or has paint on it. Put a drop of lubricant into the screw-cutting hole before you do this—it'll make the screw easier to turn, and it will keep the junk on the screw from damaging the tool.

Screw-cutting and repair are only half the battle here; the other half is repairing a screw hole. Every electrical kit should include a tool called a triple tap to deal with holes that are rusty, damaged or clogged with paint, dirt or drywall compound. The triple tap looks like a screwdriver, but its shaft is threaded, much like the tool you would use when you cut threads in a hole you just drilled. The tool's shaft is stepped to tap three different sizes of holes, hence its name. **PM**

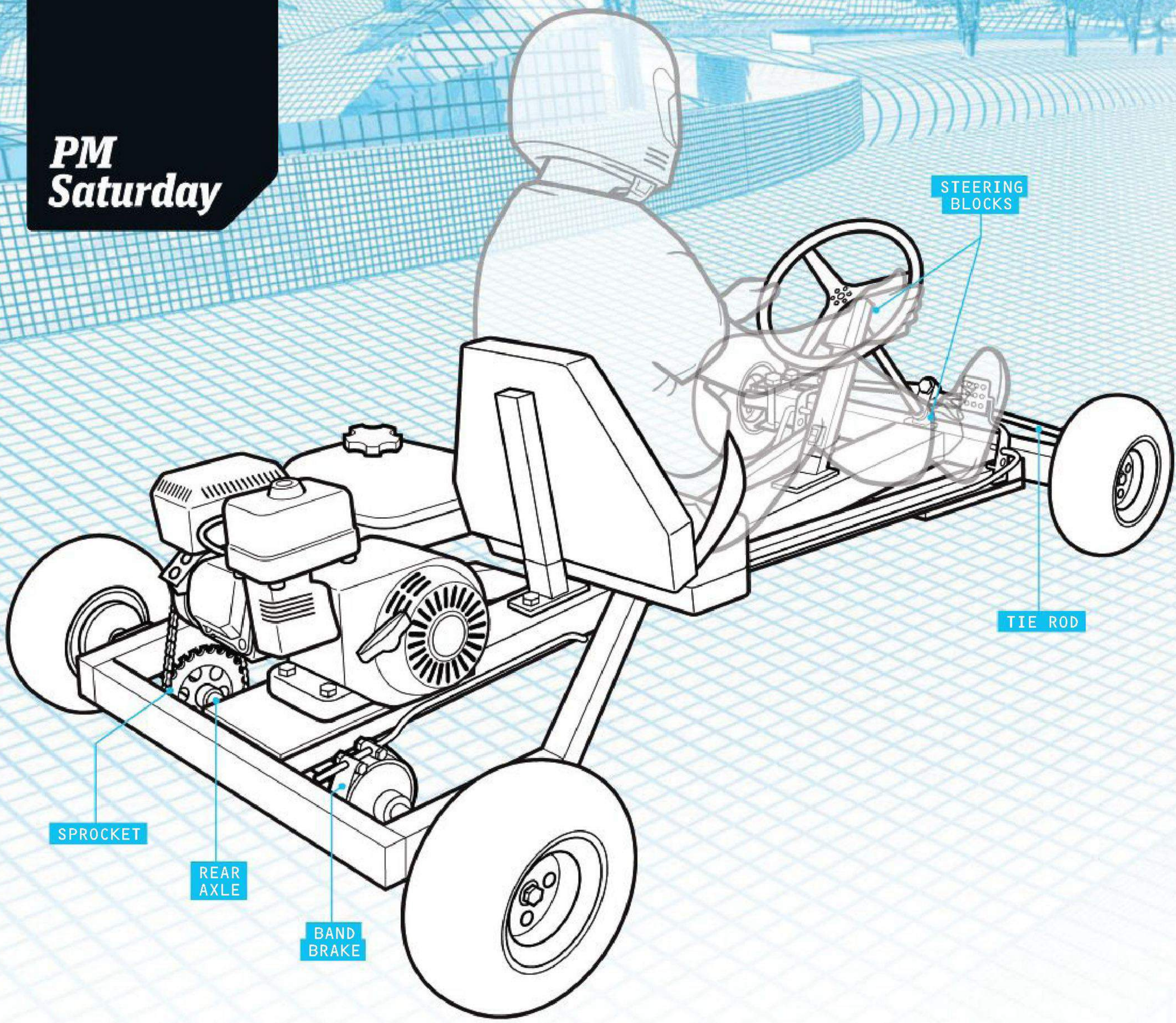
? Got a home-maintenance or repair problem? Ask **Roy** about it. Send your questions to ***pmhomeclinic@hearst.com*** or to Homeowners Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.





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+ ONE-DAY PROJECT

Build a Go-Kart

LARRY ERD HADN'T TOUCHED A WELDER SINCE SHOP CLASS—BUT THEN HIS SON ASKED IF THE TWO COULD BUILD A GO-KART TOGETHER. NEXT STOP: THE HARDWARE STORE. *BY HARRY SAWYERS*

Builder: *Larry Erd, Pompano Beach, Fla.*
Plans: *Spidercarts.com "Black Widow"*
Cost: *$689.15*

1 PLANS AND PARTS

→ Erd and his 7-year-old son, Harrison, used $14.99 plans for the "Black Widow" go-kart from spidercarts.com. Plans like these, whether they are free or require a fee, often give frame dimensions but leave steering, axle, throttle and cable connections up to the builder. Browse parts suppliers' websites to find additional advice on materials and methods. "You're on your own, but that's the fun of it," Erd says.

2 FRAME

→ Use a hacksaw or chop saw to cut metal stock to length. Clamp the steel in a vise and file or grind the cut edges smooth. Using a MIG welder, tack together the parts to check for a good fit, and make final welds to complete the frame.

3 STEERING

→ Weld an upper steering block to the top of the kart's steering post. Weld the lower steering block to the front of the frame. Screw the steering wheel to the steering shaft and thread the shaft assembly through the upper and lower blocks. Bolt a pair of spherical rod ends to the steering arm at the bottom of the shaft, using nylock nuts.

Weld spindle brackets to the front corners of the frame. Bolt the tie rods' opposite ends to the brackets' arms and connect the rods to both ends. Thread each bracket's stub axle into the front wheels' hubs. Mount the front tires on rims and bolt the rims to

ILLUSTRATION BY DAVID SANTANA (LANDSCAPE)

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ILLUSTRATIONS BY **VIC KULIHIN**

the hubs. Erd adjusted the positions of the steering shaft and tie rods until the steering performed properly.

4 REAR AXLE

→ Weld bearing hangers to the bottom face of the frame's 10-inch rear legs. Center the sprocket, Uni-Hub and brake drum on the axle. Wedge bearings between a pair of bearing cassettes and use the hardware in a bearing kit to fasten the cassettes to both hangers. (Expect to adjust the axle parts again.) On the axle ends, mount wheel hubs, fit rear tires onto the rims and bolt the rims to the wheel hubs.

5 ENGINE

→ Buy accessories together with the engine to ensure compatibility. Weld a mounting plate to the rear center of the frame, and bolt the engine to it. Add a clutch to the engine crankshaft using set screws in the clutch hub. Slide the Uni-Hub along the axle to align the axle sprocket with the clutch sprocket. Weld a bent ⅜-inch rod to the frame so it crosses in front of the brake drum to anchor the brake band. Tighten the set screws on the Uni-Hub, drum and bearings.

Loop chain around both sprockets. Remove links to adjust the chain so it has ½ inch of play.

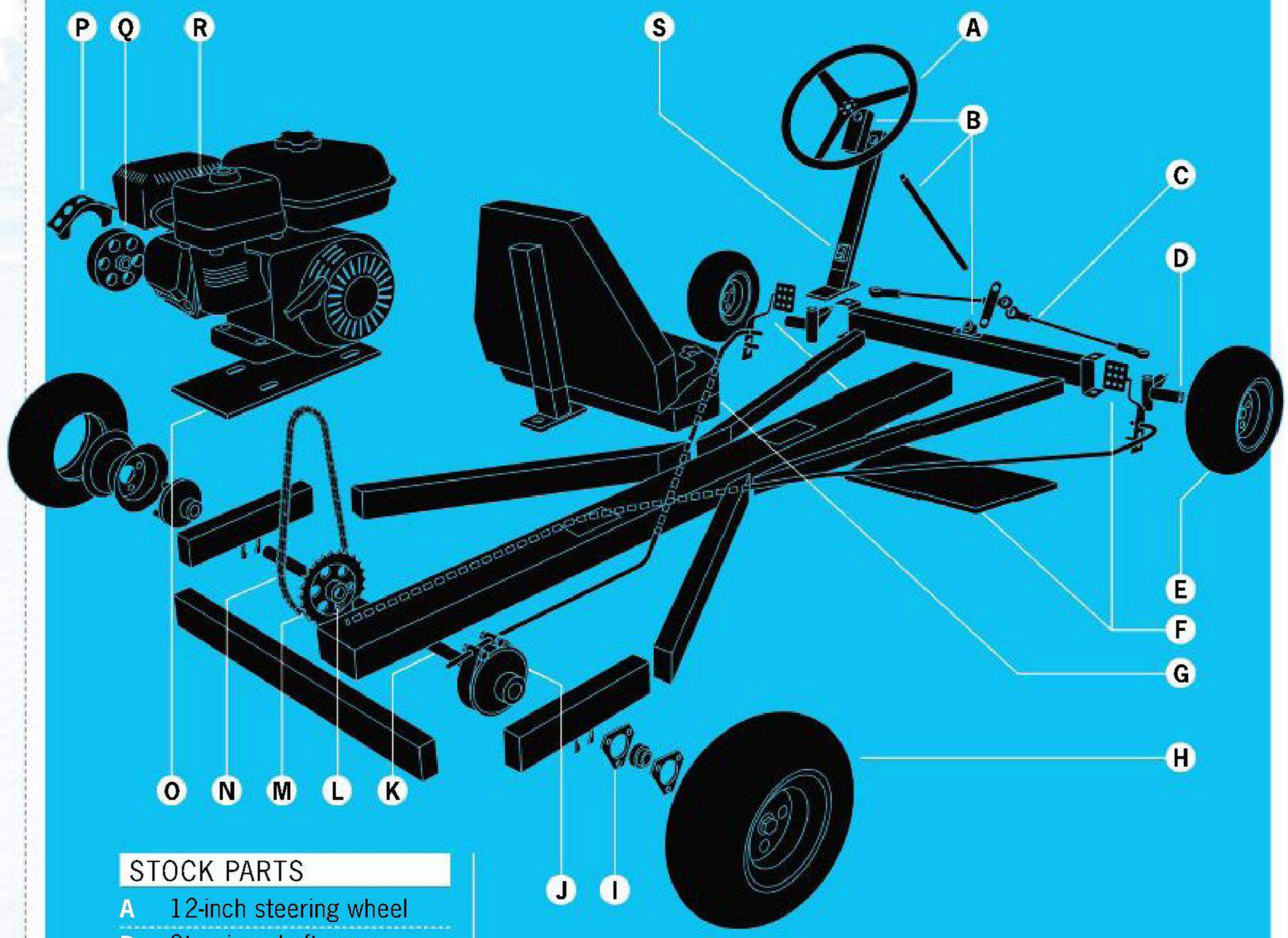
6 CABLES

→ Attach brake and throttle cables to the left and right foot pedals. Lead cables to the rear and fasten the sheaths to the frame. Pull cables just to the point of tension. Use wire stops to pin the brake cable to the upper end of the brake band so that the band can cinch around the drum to arrest the axle's motion. Pin the throttle cable to the engine throttle in the idle position. Mount a kill switch; lead the cable to the engine.

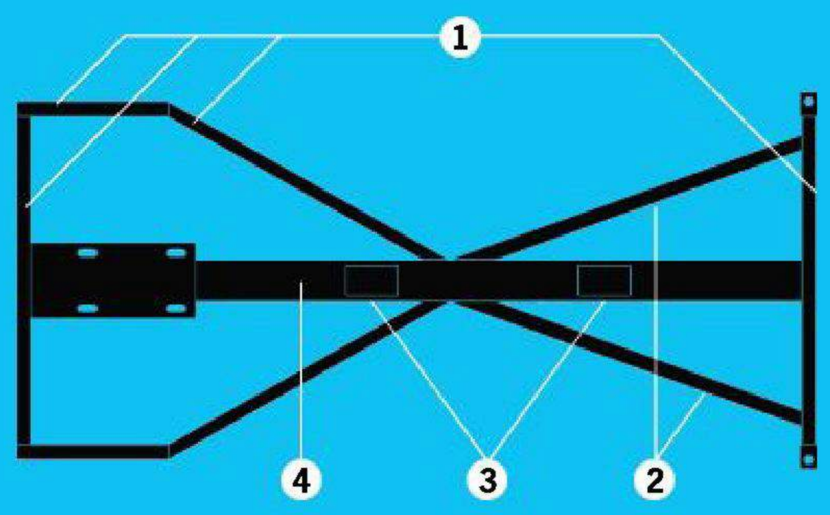
Start the engine with the kart on blocks to test the pedal connections. Erd added a floorboard so a driver wouldn't kick the tie rods (or the ground).

Make a seat by stapling vinyl and foam cushioning to plywood. Bolt it, and a seatbelt, to the seat post and the frame.

Harrison drives wearing a helmet, seatbelt fastened, while Erd supervises—and the boy has survived to see age 14.



STOCK PARTS	
A	12-inch steering wheel
B	Steering shaft, arm; steering blocks
C	13-inch tie rods (2); spherical rod ends (4)
D	⅝-inch left and right front spindle brackets
E	14-inch balloon tires, rim and hub, front (2)
F	Pedals, 60-inch brake and throttle cables, wire stops
G	Seat; seatbelt
H	14-inch balloon tires, rim and hub, rear (2)
I	Bearing kits: hanger, two cassettes, bearing (2)
J	4-inch brake drum and 1-inch brake band
K	1 x 36–inch rear axle
L	Uni-Hub for 1-inch axle
M	No. 41 54T sprocket
N	5-foot No. 41 chain
O	12 x 5–inch motor mount
P	Chain guard
Q	1-inch No. 41 clutch
R	Engine (Erd used a 6-hp Tecumseh)
S	Kill-switch kit



FRAME METAL, DIMENSIONS	
1	12 feet of 1 x 2–inch 14-gauge steel tubing. Straight cuts at 24, 26, 10 and 10 inches. Angled cuts: two pieces cut at 25⅛-inch (long face) and 23-inch (short face). Two pieces cut to 12 inches and angled at one end for seat support and steering posts.
2	6 feet of 1 x 1–inch 14-gauge steel tubing. Angled cuts: two pieces cut at 26-inch (long face), 24½-inch (short face).
3	⅛-inch steel sheet. Use two 2 x 4–inch pieces to mount the seat and steering posts. Cut pieces of 16-gauge steel sheet for floorboards.
4	5 feet of 2 x 3–inch 14-gauge steel tubing, square-cut to 56 inches for central frame support.

PARTS-SUPPLIER REVIEWS

gokartsupply.com
Of four sites consulted for parts and tips, this was the best. Great diagrams and advice. Louisiana expert Chet Dowden offers kart-building wisdom by phone or email. Motto: "In thrust we trust."

bmikarts.com
Comprehensive but cluttered parts lists, with scant description of parts' functions. Erd was satisfied shopping here. Owner Steve, unreachable by phone, did not reply to an emailed question.

go-kart-source.com
A fine source of diagrams, racing tips and technical info. No parts are for sale, and no phone number is listed on the site. An emailed form request to "talk karts" was never answered.

gokartparts.com
Not helpful by phone, but emailed questions get a prompt response from either Bill (the owner) or Bill (the tech support). A wide parts selection reflects the staff's kart-racing expertise.

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Check Engine Light?

GoPoint Technology GL1 Cable and Apps

Don't spend $100's at the dealership. Use our "Works with iPhone" certified cable to DIY! Simply plug the cable in and begin to instantly diagnose your vehicle. Decode the "Check Engine" light, diagnose poor fuel economy, and find lost performance. Works with iPhone, iPad and iPod touch. Charges your iPhone while in use. See our website for more apps.*

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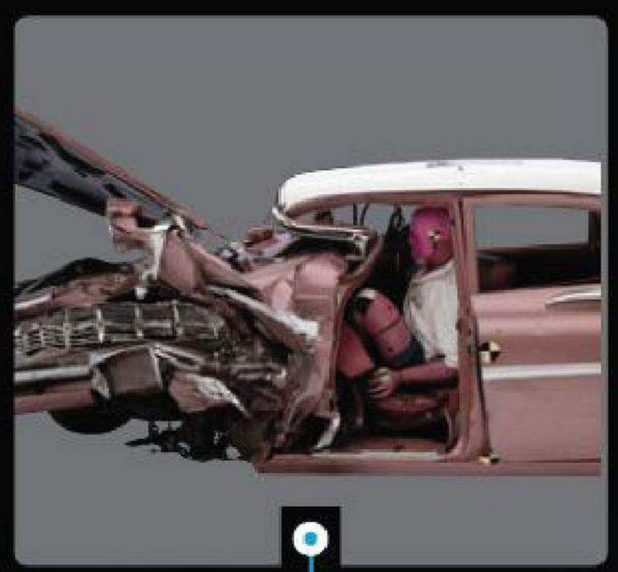
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The 2009 Malibu's controlled-crush structure and safety devices kept the driver from serious harm.



Contrast the 1959 Bel Air, which collapsed during impact, likely resulting in major injuries.





23 Ways Your Car Is Better Than Your Dad's

THINK THEY DON'T MAKE CARS LIKE THEY USED TO? THEY DON'T—AND IT'S A GOOD THING THEY DON'T. *BY MIKE ALLEN*

I get mail every day from readers (you know who you are) lamenting that the cars you grew up with were so much better than today's cars. I hear about the accident that destroyed your new Camry but would have barely scratched Pop's '77 LTD. I hear about riding in a station wagon's rear-facing seat and making faces at following motorists. Nostalgia aside, you're oh so misguided. Technology and a host of government regulations have made today's cars far more fuel-efficient, better-handling, cleaner and safer by orders of magnitude.

STAYING ALIVE

Crash Protection Thanks to car bodies and frames that are designed to absorb impact energy, and to seatbelts and airbags, these days you're far more likely to survive an accident. Recently, the Insurance Institute for Highway Safety staged a 40-mph offset impact between a 1959 Chevy Bel Air and a 2009 Malibu (above).

Accident Avoidance The surefire way to survive a wreck is to avoid having one. Antilock brakes allow you to steer around obstacles even during panic stops, while stability-control systems automatically prevent spinouts.

INSIDE STUBBORN BRAKES + SKATEBOARD FOR BIKES + ETHANOL, AGAIN

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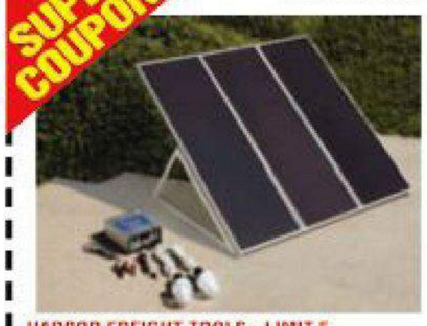
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GENERAL IMPROVEMENTS

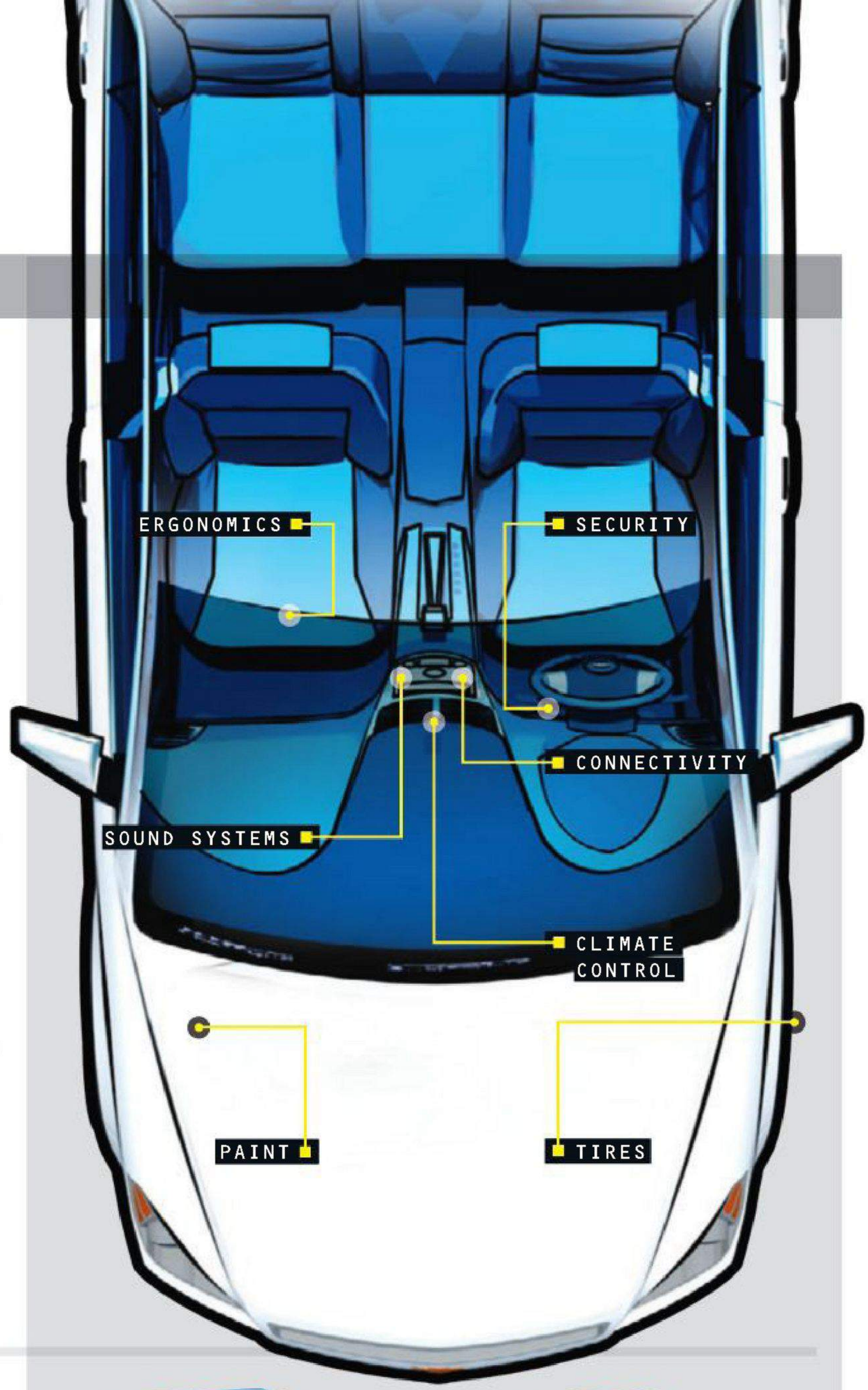
Exterior Lighting Sealed beams, mandated in 1940, replaced bulb-and-reflector designs that corroded and dimmed. Federal law required their use until the modern quartz-halogen lamp came along in 1978. Some vehicles now use HID lamps—and LEDS are just around the corner.

Tires Remember inner tubes? Tubeless radial tires have universally replaced poor-handling, short-lived bias-plys. They're so much more puncture-resistant that some new cars don't even come with spare tires. Bonus: better fuel economy due to reduced rolling resistance.

Recyclability Most of a modern car—including the plastic—is designed to be recycled. And thanks to a robust process, the modern automobile is the single most recycled object on planet Earth.

Ergonomics Dad had his choice of two colors for the cloth-covered bench seat. Now we ride around on power-adjustable, heated and cooled leather buckets, grasping leather steering wheels that have radio and telephone controls on the spokes. All the major controls are now within easy reach, and we even have automatically dimming rearview mirrors.

Aerodynamics Every car designer has to study aerodynamics to get a degree. Attention to airflow has reduced the drag coefficient of a Mustang from 0.46 in 1979 to 0.36 today.



UPGRADES

Paint

Henry Ford painted Model Ts with black lacquer and a paintbrush. Except for spray guns, the process didn't improve much until paint-booth emissions requirements made carmakers adopt durable clear-coat enamel in the '80s.

Connectivity

Getting your mail in older cars meant driving down the lane to the mailbox. Now you can tweet from the dashboard, send maps to the nav system from your cellphone and let your car schedule its own service appointments.

Security

It's ridiculously easy—without any tools—to hot-wire a classic car. Contrast that with the rolling-code transponder keys and immobolizers in modern cars. You can even follow a stolen car online, and shut it off for the police.

Climate Control

Air conditioning is now standard on almost every new car. And many come with multizone controls that can be tailored for driver, passenger and even rear seats.

Sound Systems

AM radios ruled, and the upgrade was pushbutton tuning. Modern car stereos are more powerful and full-featured than the best home audiophile systems of 20 years ago.

ILLUSTRATIONS BY **DAVID SANTANA**

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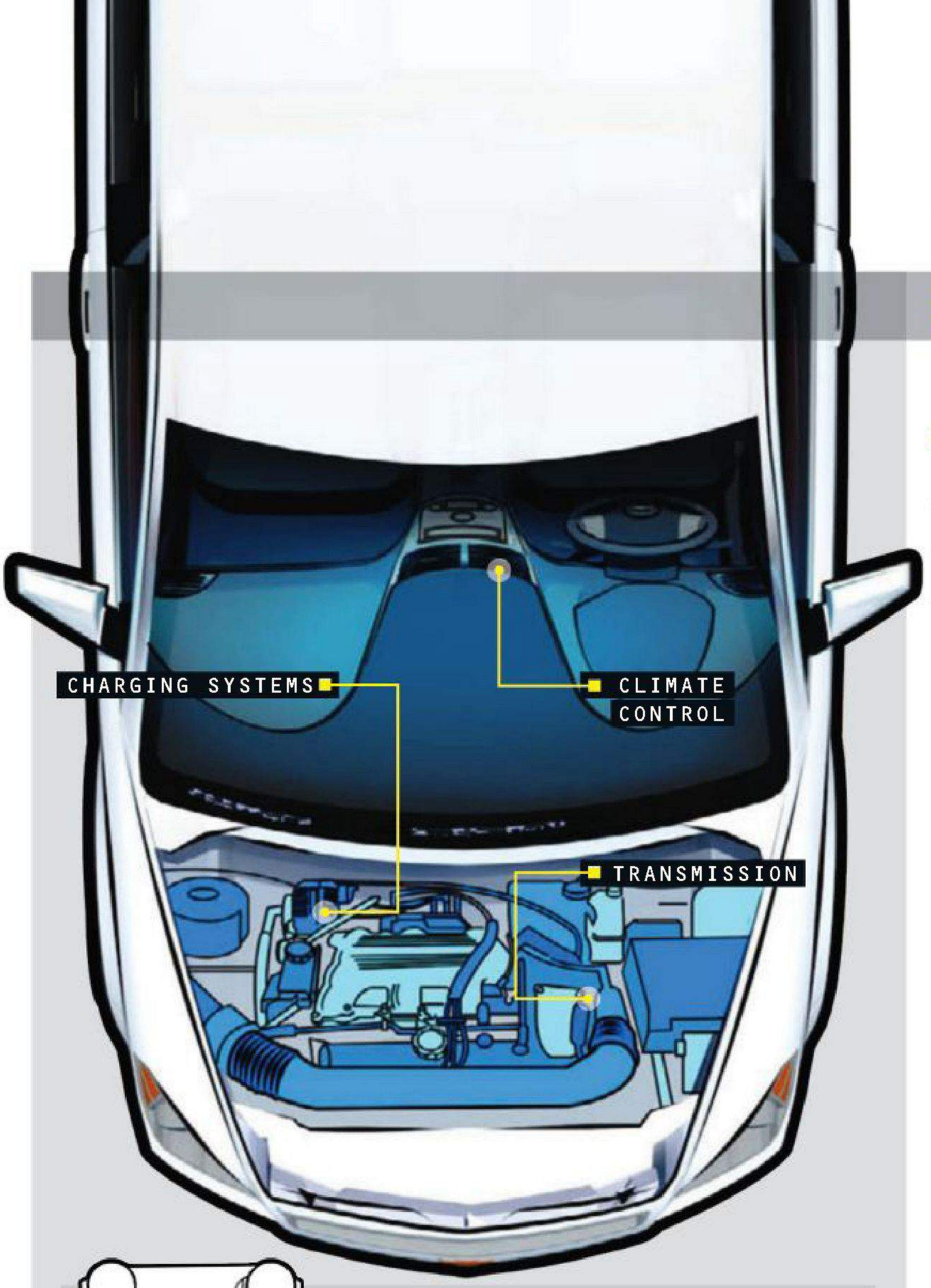
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UNDER THE HOOD

Fuel Economy

	2011 IMPALA	1970 IMPALA
WEIGHT	3555 pounds	3935 pounds
SAE HP	211	≈200
0–60	8.9 seconds	9.4 seconds
MPG	18/29	12.3

Engine Diagnostics

Your dad's mechanic had to be a cross between a horse whisperer and a rocket scientist to keep a carbureted, ignition-points car running smooth. Now the engine tunes itself, and you can monitor its operation with an iPhone app.

Engine-Specific Output

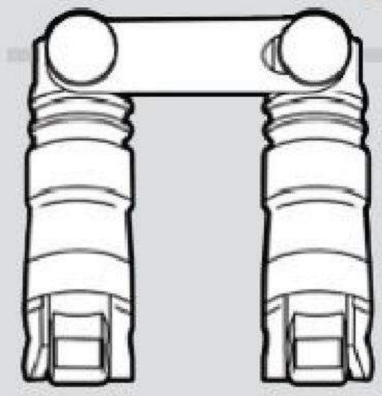
In the old days, only temperamental race motors produced 100 hp for each liter of displacement, and they needed frequent rebuilds. Today, you can buy a $22,995 Honda Civic Si that delivers 100 hp/liter and will run nearly forever.

Transmissions

The gold standard used to be a three-speed automatic with a slushy torque converter. In the interest of fuel economy and quieter cruising, we now have seven-speed automatics, locking torque converters, continuously variable transmissions and quick-shifting automated dual-clutch gearboxes.

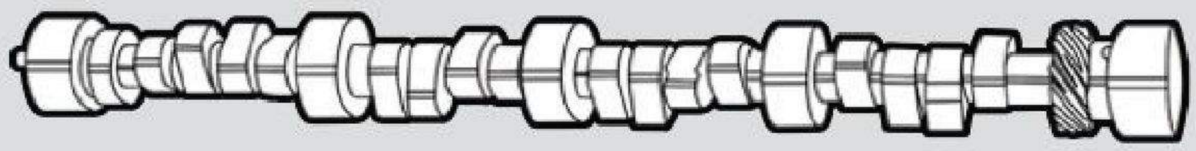
Charging Systems

Weak, whining generators went bye-bye in the '60s: New cars have at least a 100-amp alternator; most are 135 amps.



Low-Friction Engines

Attention to detail in the engine has reduced fuel consumption considerably. For example, this roller camshaft (left) replaces high-friction tappets with free-rolling, needle-bearing cam followers.



QUALITY CONTROL

Ride

Solid axles are still used on trucks, but cushy independent suspension is now the norm. Some cars use electronically controlled shocks that change settings before the wheel sinks into a pothole.

Reliability

Back in the day, the average car was lucky to wheeze along to 100,000 miles. Now it's not unusual to see twice that on the odometer. And when was the last time you heard of a catastrophic engine failure?

Maintenance

Imagine having your oil changed every thousand miles, and pumping grease into a dozen suspension fittings. Most cars now have sealed suspension joints, and oil-change intervals are as long as 12,000 miles.

Emissions

Drive behind a '60s vintage car and the acrid exhaust fumes will burn your eyes. Today's cars emit less than 1 percent of the smog-producing chemicals that cars put out four decades ago, and very little carbon monoxide.

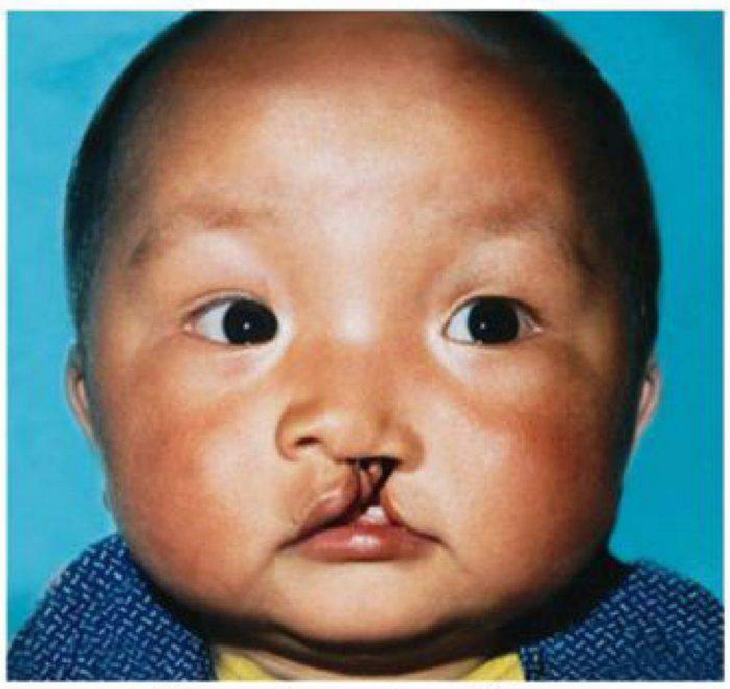
Handling

Modern cars have precise power-assisted rack-and-pinion steering gear, grippier tires and far better suspension kinematics. Now you control where the car goes, not the other way around.

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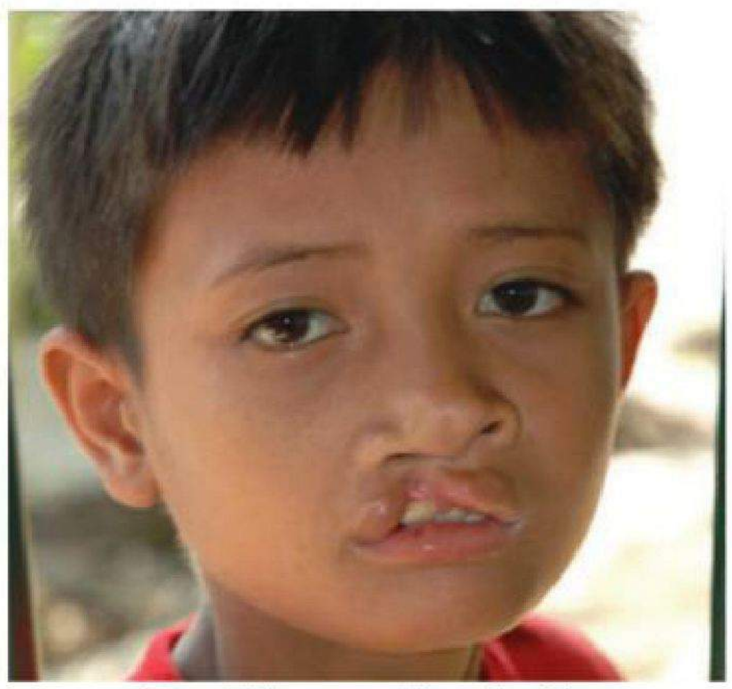
Each Of These Kids Needs Somebody Who Cares Enough To Send $250. Once.



Ming, 6 months, China



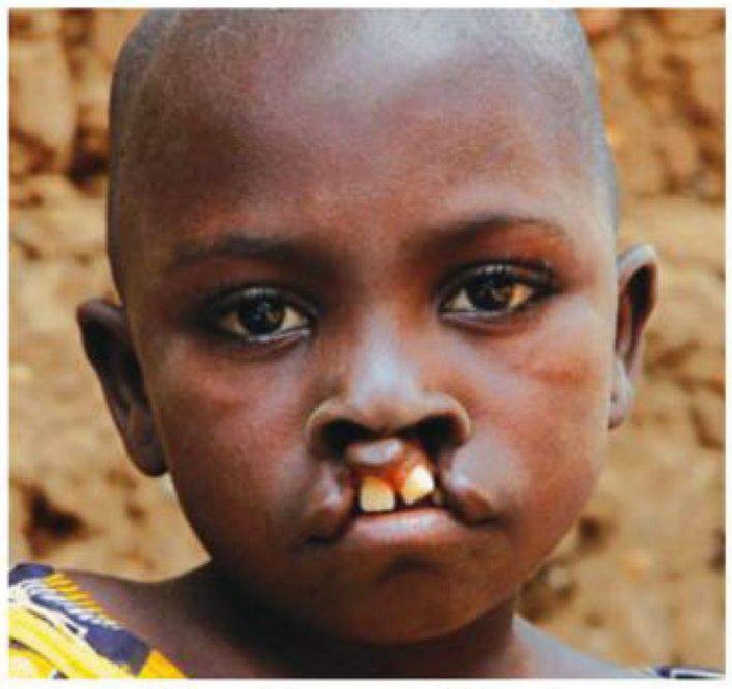
Shiva, 1 year, India



Mot, 13 years, Cambodia



Durgap, 5 years, India



Funmi, 8 years, Nigeria



Salazar, 5 years, Philippines

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Q+A

Stuck on You

I wanted to machine the rear brake discs on my new-to-me used car when I replaced the brake pads. But no amount of tugging or banging would budge them from the hubs.

Remove this stuck brake drum—after you back off the brake shoe adjustment—by alternately turning a couple of bolts into the tapped holes to push it off.

A Moisture will eventually work its way into the interstices between the disc (or drum) and the hub face or studs, causing rust. Rust is physically larger than the iron that it replaces, and the resulting buildup of pressure can freeze tightly fitted parts together. To make your life simpler, many late-model brakes, discs and drums have small tapped holes in the face of the casting. Just thread a bolt into the hole, and turn. The bolt will bottom out on the hub, pushing the disc/drum free.

A few discs will have a small Phillips-head machine screw that holds the disc tight to the hub face to keep it from falling off during wheel changes. (You should have this problem, right?) After the screw is removed, the disc should pop off easily, unless corrosion (see above) has welded them together. Stay tuned.

Some discs, notably on older cars, are just obstinate. My usual routine is to bang alternately on the flat part of the disc between the studs and on the perimeter of the disc (not on the friction surface of the disc, which might actually bend) with a lead or dead-blow hammer. Some penetrating oil wouldn't hurt, either. When that doesn't work, which it usually doesn't, add some heat. A propane torch is good; an acetylene torch with a rosebud tip is better—remember that brakes are designed to

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dissipate heat, and will soak up a lot of it before they really get hot. Apply heat, again, right in between the studs. Bang with your hammer while the iron is hot. No go? Chill with cold water, lather, rinse; repeat. In theory, the alternating heat and cold will crumble the rust that's bonding the whole shootin' match together.

Last resort: Borrow or rent a big gear puller, but plan on replacing the disc—it'll bend up like a Pringle before it springs free.

Now that you have it apart: When you go to reinstall it, start by wire-brushing or Scotch-Briting all the corrosion off the mating surfaces of the hub and disc. If there's a line of rust lurking in the inside corner of the disc's mating flange, use something pointy to get every last vestige out. Then lightly coat one of the surfaces with some anti-seize compound. Next time you're in there, you should be able to pull it apart by hand.

Switch to Decaf

My 1999 Chevy S-10 makes a weird noise; it sounds like it is coming from right under the dash, sort of like a percolator perking coffee. My uncle says that it is the odometer cable rubbing the lining. If it were the odometer cable, wouldn't the noise be present all the time? And not when the vehicle is stopped at a red light?

This is probably caused by air bubbles in the cooling system gurgling as they flow through the heater core. Modern cooling systems are notoriously hard to bleed of excess air. Start by making sure the overflow reservoir is filled to the cold, or hot (depending on how warm the engine is), line, and that the radiator cap and hose to the reservoir are not leaking air. Check the hose and the cap's rubber seals and the radiator's mating surface. The radiator should be brimful of coolant, not just full enough to cover the tubes. If air isn't entering the system, eventually the bubbles should work their way to the overflow reservoir and vent to the atmosphere, at least in theory.

Warning: Some vehicles require an

MIKE'S TOOLBOX

YOU NEED THIS

I was moving furniture around my house last month, and realized how simple a furniture dolly makes shuttling large, heavy stuff around the living room. That's the same principle as the Park-n-Move motorcycle dolly. It has made parking my motorcycles simple—no more eight-point K-turns to maneuver the big touring bike around. Constructed of stout ¾-inch powder-coated plate steel, this gadget will do 360-degree rotations under your bike with a light push. To mount the bike, just tuck the $199 device under the center-stand legs and pull the bike rearward as you would to park the cycle. No center stand? They make a cruiser model with its own built-in stand for $299. There's also a low-profile version for big touring bikes (legalspeeding.com).



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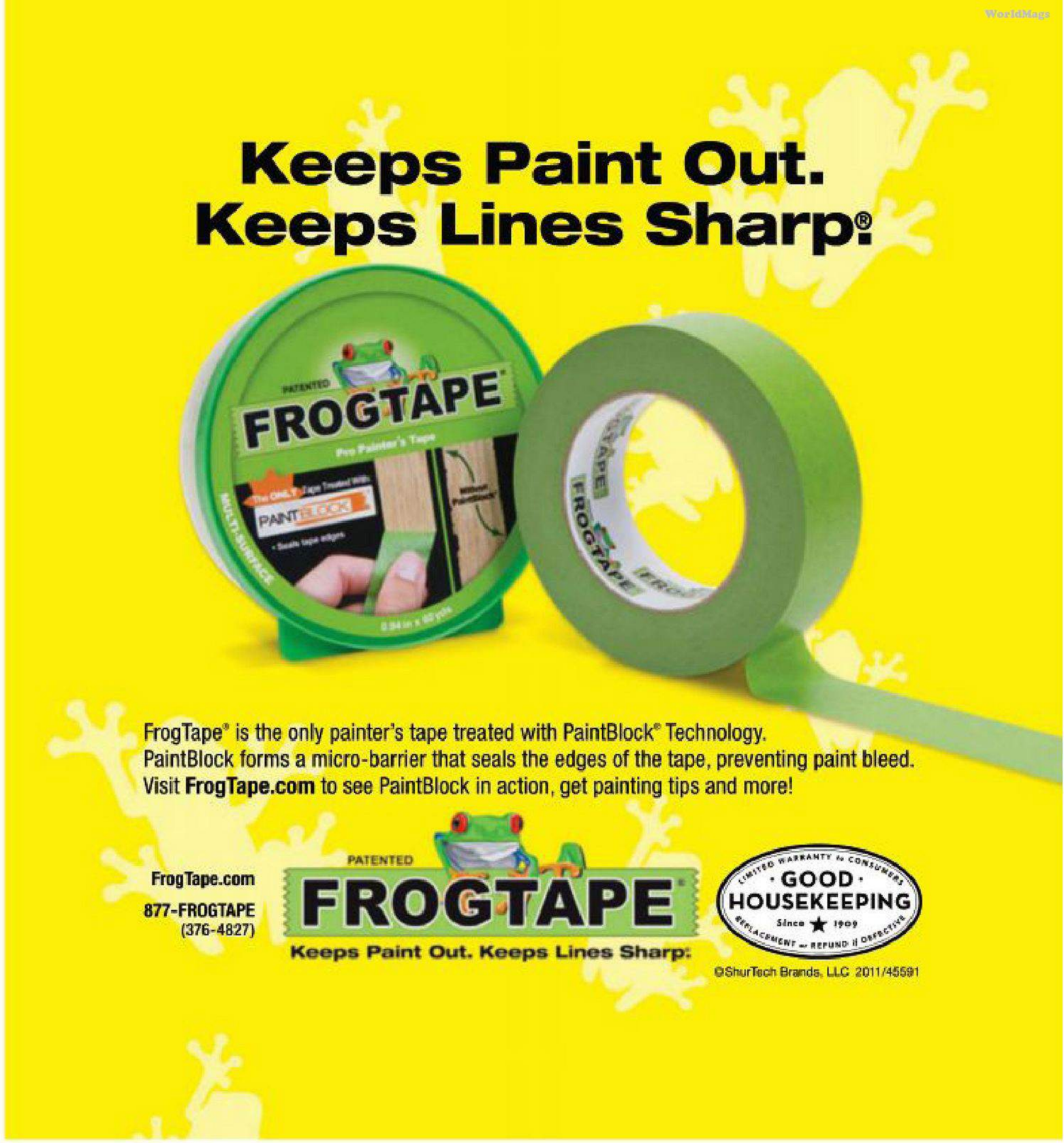
elaborate bleeding process to eliminate enough air to get coolant flowing at all. Skimping on the bleeding may cost you an overheated engine.

Over the Hill

I own a 2000 Ford Excursion diesel 4x4. After I reprogrammed the computer to increase the boost pressure (it netted about 60 hp), the fuel economy rose to 18 to 20 mpg when the truck is empty and 12 to 14 when towing 10,000 pounds. That's at a steady 60 mph with the engine revving at 1700 rpm. If I increase my speed to 65 mph, the engine rpm climbs to 2150 and the fuel economy drops to 14 to 16 empty and 8 to 10 loaded. I am going to rebuild the front drivetrain anyway, so I'm thinking of either installing a taller final-drive ratio in both axles or somehow adding an auxiliary overdrive unit. Which affects the computer more?

The computer and engine won't care at cruising where the taller gearing comes from—either from upping the final-drive ratio in the axles or from adding a third-party overdrive. But that's at cruising speed. Upping the axle final-drive ratio may make it difficult to get the whole freight train moving or to climb hills when you're towing heavy loads, because the ratio change will also affect the engine rpm when the transmission is in the lower gears. The overdrive unit, on the other hand, can be shut off for low-speed operations and simply reserved for flat or downhill steady-state highways. But auxiliary overdrive units run between three and five grand—plus installation, if you're not doing it yourself—and you can buy a fair amount of diesel for that much. If you already need to replace one axle, or at least the ring and pinion gear, simply doing the other ring and pinion set at the same time isn't going to be that much money. If you live where it's mostly flat, the taller gears might not make the truck too sluggish off the line.

You need to make some decisions. Figure out how many miles you tow annually. Calculate your fuel costs, and then work out how long it will take to recoup your investment. If your truck is already 10 years old, it may not be





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worth your while. On the other hand, with what I paid for a tankful of diesel yesterday, maybe so.

Topped Off

I like to check my fuel economy every tankful. Should I let the pump shut itself off, or should I fill the tank right up to the top of the filler neck?

In theory it doesn't matter, as long as you always do it the same way. For the most accurate fill-ups: Top off first thing in the morning when the gas in your car is at atmospheric temperature, not heated up from passing through the fuel pump and recirculating in the engine compartment. Find a station and pump with a slight slope that puts the filler neck a bit higher. Top off only once after the automatic shutoff. I generally let the pump click off on its own, wait 10 seconds for all the foam to clear, then add more fuel—slowly—until the pump clicks off again. In general, it's a bad idea to top off the tank as high as you can. As the fuel, which is stored in a cool underground tank, warms to atmospheric conditions, it expands, potentially flowing into the evaporative-emission-system charcoal canister, a part that's designed to handle fuel vapor, not liquid.

Swap Meet

Can a Chevy Astro van with a 4.3-liter V6 be modified to accept a diesel motor? Would it be too much trouble?

Short answers: Yes. And probably. Long answer: With enough time, determination and money, you can do anything. But why would you want to?

Your Astro is at least 16 years old (they stopped production in 1995). Odds are it has substantial mileage on it, so the rest of the van is not exactly showroom-new. Assuming you can find some diesel motor that fits into the Astro's diminutive engine bay and bolt it up to some acceptable transmission, you'll need to fabricate engine mounts, transmission mounts and probably a driveshaft. The diesel will need a different fuel-pump arrangement, so you'll be removing and modifying the tank and updating the rest of the fuel system. You'll need to remove the evaporative emission control system (EVAP), which is of questionable legality in many states. (You don't live in California, do you? If you do, turn the page now.)

I suppose if you have a suitable diesel around, and a well-equipped shop, and a lot of time on your hands, it could be done. But with diesel fuel selling for 48 cents a gallon more than regular last week, what's the point?

Don't Be Wasted

I drive a Lexus ES 350, which has a 10.5:1 compression ratio. I have been running on 91-octane fuel. Now that all fuel is mixed with 10 percent ethanol, which has a higher octane than gas, am I wasting my money on the high-test fuel?

While adding alcohol to gasoline will raise its octane measure (ethanol has an octane rating of 108), the octane rating on the pump already includes the contribution of the

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ethanol in the mix. So, technically, your high-performance, high-compression engine will run best on the grade of gasoline specified by the manufacturer. Like most modern OBD-II engines, it will also run fine on lower-octane fuel (albeit with poorer fuel economy and lowered performance) by seamlessly retarding the timing and richening the mixture to eliminate spark knock. And at the premium they get for high-test these days, why pay for it if you don't have to?

Obstructed Vision

When there is a light rain or fog, my windshield gets really splotchy, like it's dirty—yet it's clean. This makes it hard to see sometimes. But as soon as the rain picks up, the issue seems to disappear. I suspect the previous owner tried putting Rain-X on the windshield and did a shoddy job. Any way to correct this?

Just clean the windshield with some Bon Ami, or even some fine autobody rubbing compound, to get whatever contaminant is left—probably wax, because Rain-X doesn't do that—off. Then apply some Rain-X according to the directions on the bottle.

Lights Out

I forgot to put my gas cap on after filling up, and traveled 200 miles before I realized it. Yet to my surprise, the Check Engine light didn't illuminate. I had my car serviced and told them what happened and was told that the light would not come on if the cap was left off when the engine was warm. So, for the next few days, I removed the cap before starting my cold engine. I tried this several times, and the Check Engine light never came on. What gives?

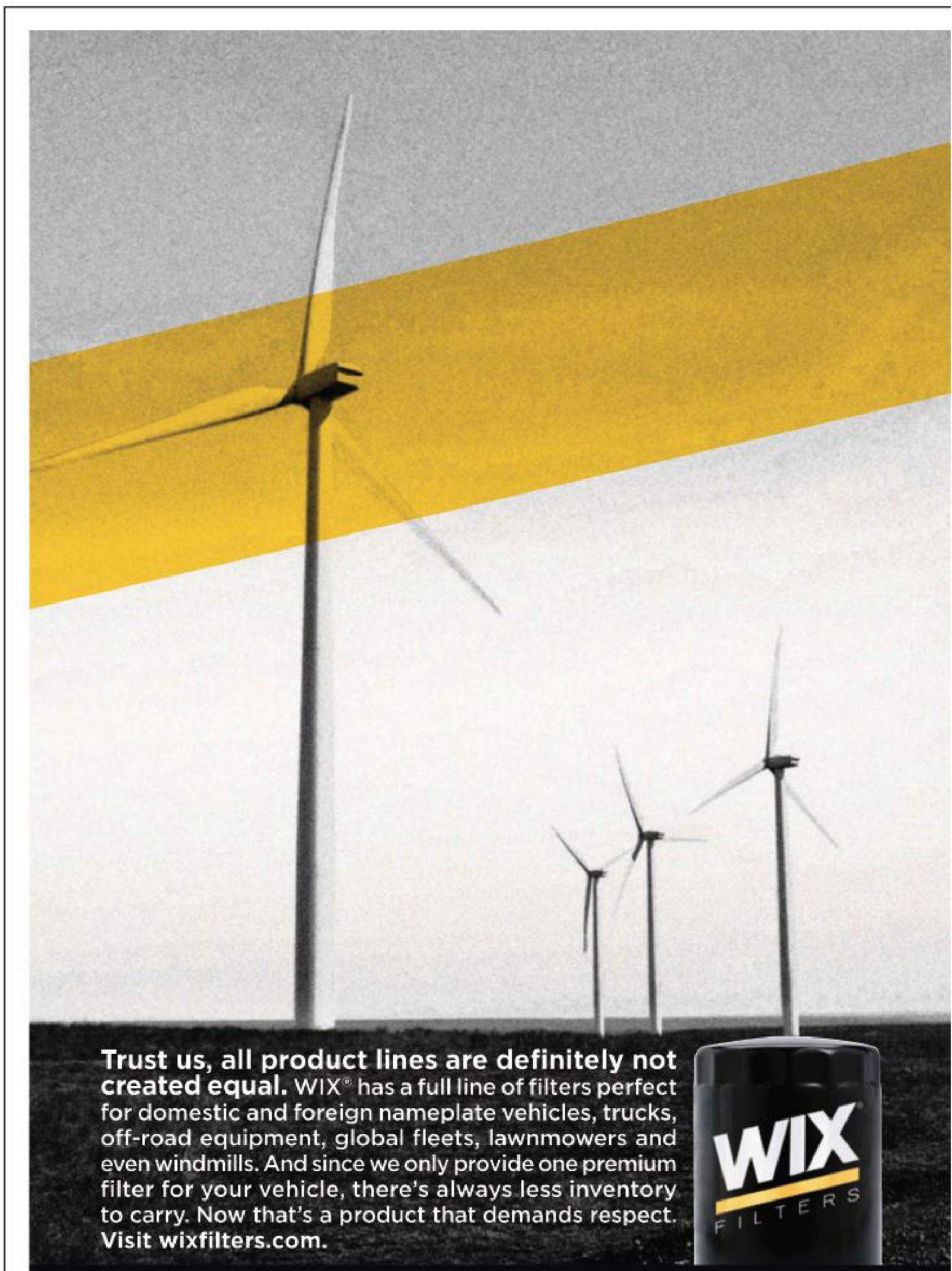
The evaporative emission control system (EVAP) on your car is designed to keep gasoline fumes bottled up inside the tank and inside a canister full of activated charcoal. The fuel vapors are slowly vented back into the engine when it's warmed up and running. This will have no effect on fuel consumption because the engine computer compensates while this is done and keeps the air-to-fuel ratio correct.

The EVAP does a periodic self-check to see if it's performing properly, and one of the things it does is check the pressure in the fuel tank, which is normally a pound or three above atmospheric, due to the gasoline's vapor pressure.

Leaving the gas cap off is a favorite way to make the system fail this test. Or just not screwing on the cap tight enough, as many car owners have found after an expensive visit to the dealer to have their gas caps tightened.

You've neglected to mention to me what make, year and model of car you have, so I have to speak generically. Different cars perform this self-test at different intervals and according to different criteria. Your car simply didn't happen to come around to a periodic self-test while the cap was off. **PM**

Got a car problem? Ask **Mike** about it. Send your questions to **pmautoclinic@hearst.com** or to Car Clinic, Popular Mechanics, 300 W. 57th St., New York, NY 10019-5899. While we cannot answer questions individually, problems of general interest will be discussed in the column.



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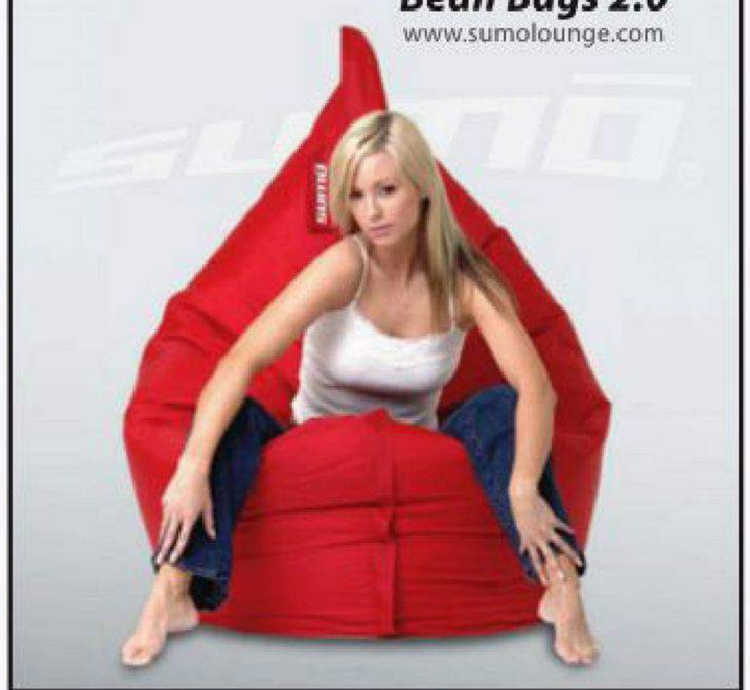
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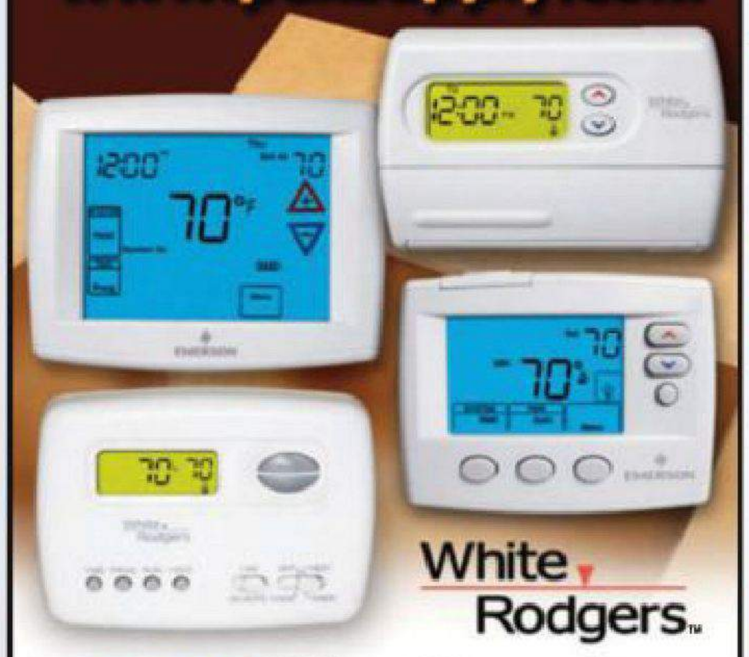
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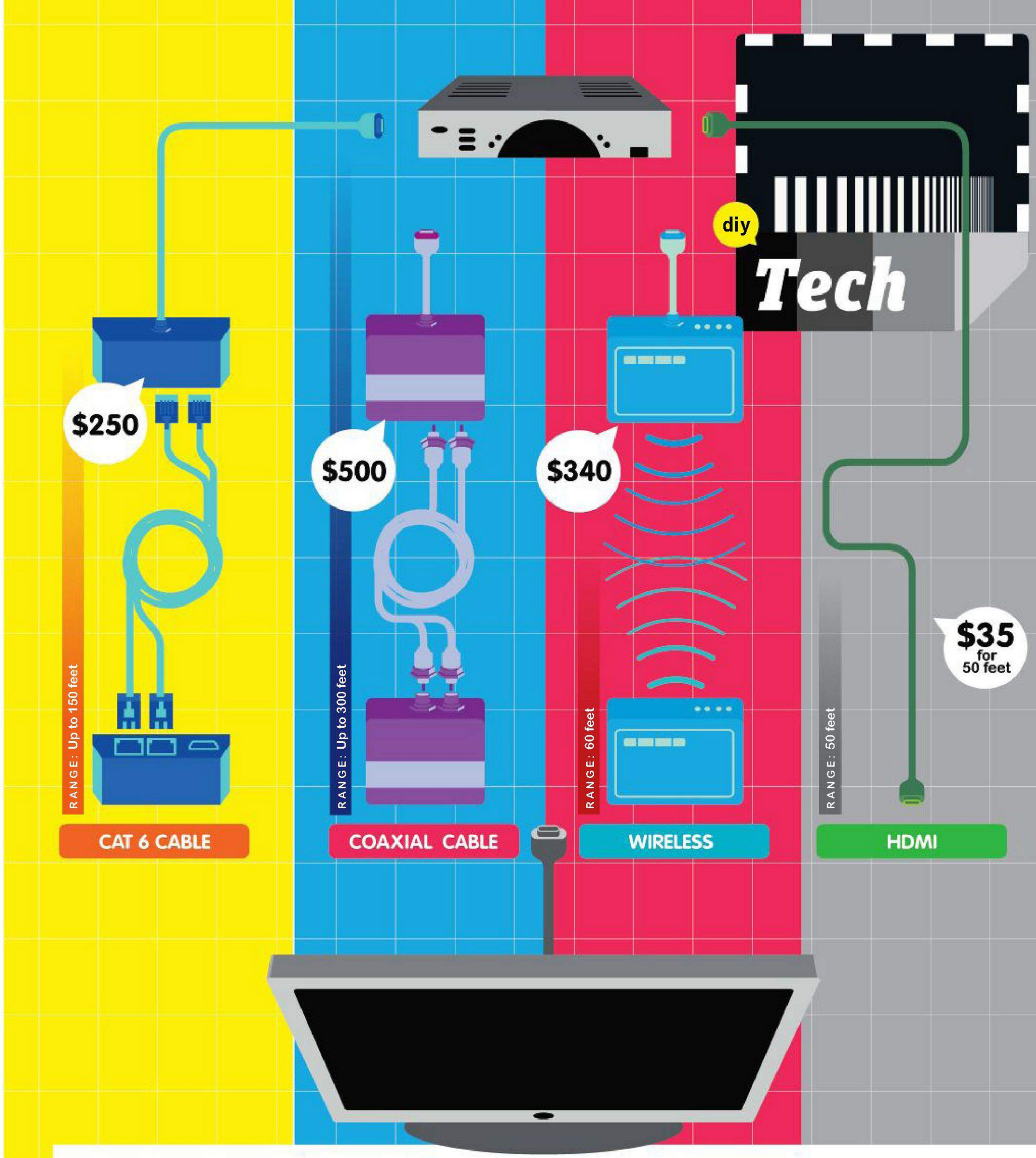
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Extending Your HDMI Cables

IN THE HI-DEF ERA, ALL AUDIOVISUAL SIGNALS TRAVEL OVER ONE CABLE. BUT THINGS GET TRICKY WHEN THAT CABLE HAS TO COVER A LONG DISTANCE. *BY JOHN HERRMAN*

Let's give the HDMI cable some credit. It helped clean up the tangled mess of wires behind our TVs, gave us a way to quickly link a stunning range of devices with a new generation of displays and provided a sturdy backbone for the HD revolution. But for everything this unassuming all-in-one cable can handle, sometimes it comes up short.

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Like many video, audio and data cables, HDMI cords can suffer from signal degradation at longer lengths—50 feet is generally considered the maximum reliable length. And it's rare to see an HDMI cable longer than 25 feet in a store. Even online, cables more than 50 feet long can be hard to find. If your TV, set-top box and other AV equipment are all on the same piece of furniture, this isn't much of a concern. With a collocated setup, you'll probably never need more than 6 feet of cable at a time.

But HDTVs have introduced a whole new way of arranging home theater gear. Flat screens are increasingly thin and lightweight, and their picture-frame profiles make them perfect for hanging on walls. Similarly, HD home theater digital projectors are now affordable enough for nongazillionaires to set up a basement cinema. A clean installation of either of these setups generally requires a bit of in-wall wiring, sometimes even from one room—an AV closet, for instance—to another. And when you're fishing wires up into ceilings, over doors and under floors, the necessary spool of cable gets long quickly. Here are the alternatives.



INSIDE THE WALL

HDMI qualifies as low-voltage wiring, so wall plates can be attached with a simple bracket rather than a standard electrical box. Since you can't terminate HDMI wires yourself, look for wall plates with an internal female connector.

Cat 6 Piggyback

One commonly used solution to cable-length limitations is something called HDMI over Cat 6. Steven D'Addone, co-owner of Intra Home Systems in New Jersey, an installer of high-end audiovisual systems, swears by the technology. "We only run Cat 6," he says.

Here's how it works: A video source, such as an HD cable box, is connected to a small device—a "balun," in the parlance of the trade—with a short HDMI cable. The balun usually takes the form of a small, router-like box or a wall plate. Its job is to pass the HDMI signal along to one or more Cat 5e or Cat 6 cables. (These are the same cables used to wire Ethernet networks—Cat 5e is a more common cable, but the newer Cat 6 standard is preferred by AV installers for its higher bandwidth.) At the receiving end, a similar box passes the signal back onto an HDMI cable, which then connects to your display.

Now, all HDMI over Cat 6 baluns are not created equal. Some crudely bridge the HDMI and Cat 6 cables by relying on the signal power of the original video source—this limits the range considerably. Others compress and then decompress the HDMI signal, but this can cause hardware compatibility problems. D'Addone recommends a third type of system. "What seems to be the most reliable are products that are high-bandwidth and powered on both sides," he says. These boxes, which can be found for about $100 each, create a direct bridge between HDMI and a pair of Cat 6 cables, but provide extra power to ensure the signal can travel distances up to 150 feet.

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Best of all, powered HDMI over Cat 6 preserves the quality of video and audio signals. And given the low cable price—about a dollar per 10 feet online—HDMI over Cat 6 makes the most economic sense for longer throws.

Copper and Fiber

For distances up to 300 feet, similarly priced adapters are available that make use of coaxial cable. One catch: HDMI over coaxial solutions usually require a minimum of two coax cables, and often as many as four. This means that existing household coax installations, which generally make use of only a single cable running to each connected room, won't be of much use.

For even *longer* runs, you'll have to leave the world of copper for fiberoptics. While the fiber itself is cheap, adapter hardware is pricey ($500-plus per box). In addition, DIY installation is a complicated and difficult proposition, and professional installation makes the setup even more expensive.

Cable-Free

What if you'd like to lug your TV into the backyard for the big game? Or maybe you rent your home and aren't permitted to string cable through your walls. In these cases, you can bypass wires entirely.

"Wireless HDMI" is a phrase thrown around a lot, but it doesn't refer to an official standard or even a specific technology. Rather, it's a blanket term for a variety of wireless products that transmit video signals using proprietary wireless standards. These work by stationing a transmitter near the video source and a small receiver by the TV.

Wireless HD systems can be useful, but they have limitations. In most products, broadcast ranges top out at around 50 feet. Unlike HDMI over Cat 6, wireless HDMI solutions tend to degrade image quality—not fatally, but enough for a discerning eye to notice. Signals are also prone to unpredictable interruptions, just like you sometimes experience with Wi-Fi. Lastly, these devices aren't cheap: To get reasonable reliability, range and image quality, you'll probably want to go with a major brand—Philips or Sony, or for a higher-end setup and longer ranges, Gefen—and spend at least $300.

Good Old HDMI

Before dropping hundreds of dollars on HDMI extenders or wireless transmitters, make sure it's really necessary. For runs 50 feet and under, an HDMI cable is still your simplest option. And don't go for the high-priced cables found in retail stores. For the $50 you might spend on 10 feet of cable at Best Buy, you can nab a 50-footer from a reputable online seller such as Newegg or Monoprice. HDMI can be fished and installed in-wall almost as easily as coaxial or Cat 6 cable. (Although, thanks to HDMI's security features, you cannot cut the cable to an exact length and apply fittings yourself, which means you generally have to overbuy and leave a bit of slack in your walls.) So be sure to measure out the distance between your equipment and TV before you invest in a complex system. It may turn out that an HDMI cable is the cheapest and easiest solution after all. **PM**



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Digital Clinic

by Seth Porges

Q+A



iSpy a Missing Phone

I'm the kind of guy who seems to always lose his phones. Any tips on getting them back?

A Not so long ago, losing a phone to the clutches of a cab, couch or thief pretty much meant game over—your chances of getting the missing device back were somewhere between nil and zilch. Well, today's phones aren't called smart for nothing, and there are now plenty of apps that give us at least a fighting chance of tracking down a wayward phone.

As you might guess, these apps typically work by using the phone's GPS chip as a homing beacon, allowing you to see the device's location on an online map. Some of them also contain other security-minded features, such as the ability to send messages to anybody who might have stolen or stumbled upon your phone ("GIVE IT BACK!"), sound a phone's alarm, lock the device if you didn't set it with a password, or even remotely wipe it if it's full of sensitive information. These controls are typically handled from either a Web interface or, in some cases, through a friend's phone that has the same app installed.

Just about every smartphone platform has its share of free and pay phone-recovery apps. In my experience, most of these programs handle their core functionality (that would be showing a phone's location on a map) beautifully. In case the missing gadget is in motion (say, left behind in a cab), some apps even allow you to watch it move across a map in real time. That creates interesting stakeout and sting potentials for stolen phones (though you're probably better off just calling the cops).

If you've got an iPhone, the best solution is Apple's own free Find My iPhone app. (There are also versions of the app available for tracking down a missing iPad or iPod Touch.) A good pick for Android, BlackBerry, Symbian and Windows Phone users is McAfee WaveSecure ($19.90 per year). I'm also a fan of the free Android app Prey, which can quietly send you a continuously updated feed of snapped photos and GPS locations without letting a thief know what it is up to.

Predictably, these apps aren't bulletproof. If a thief disables a phone's GPS, some apps are capable of remotely switching it back on, but others are not. And if you're using a GSM phone (basically, one that requires a SIM card) and

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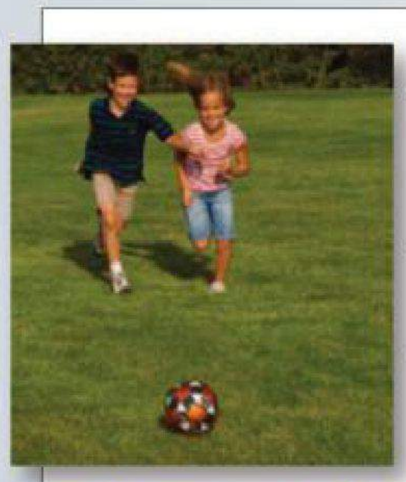


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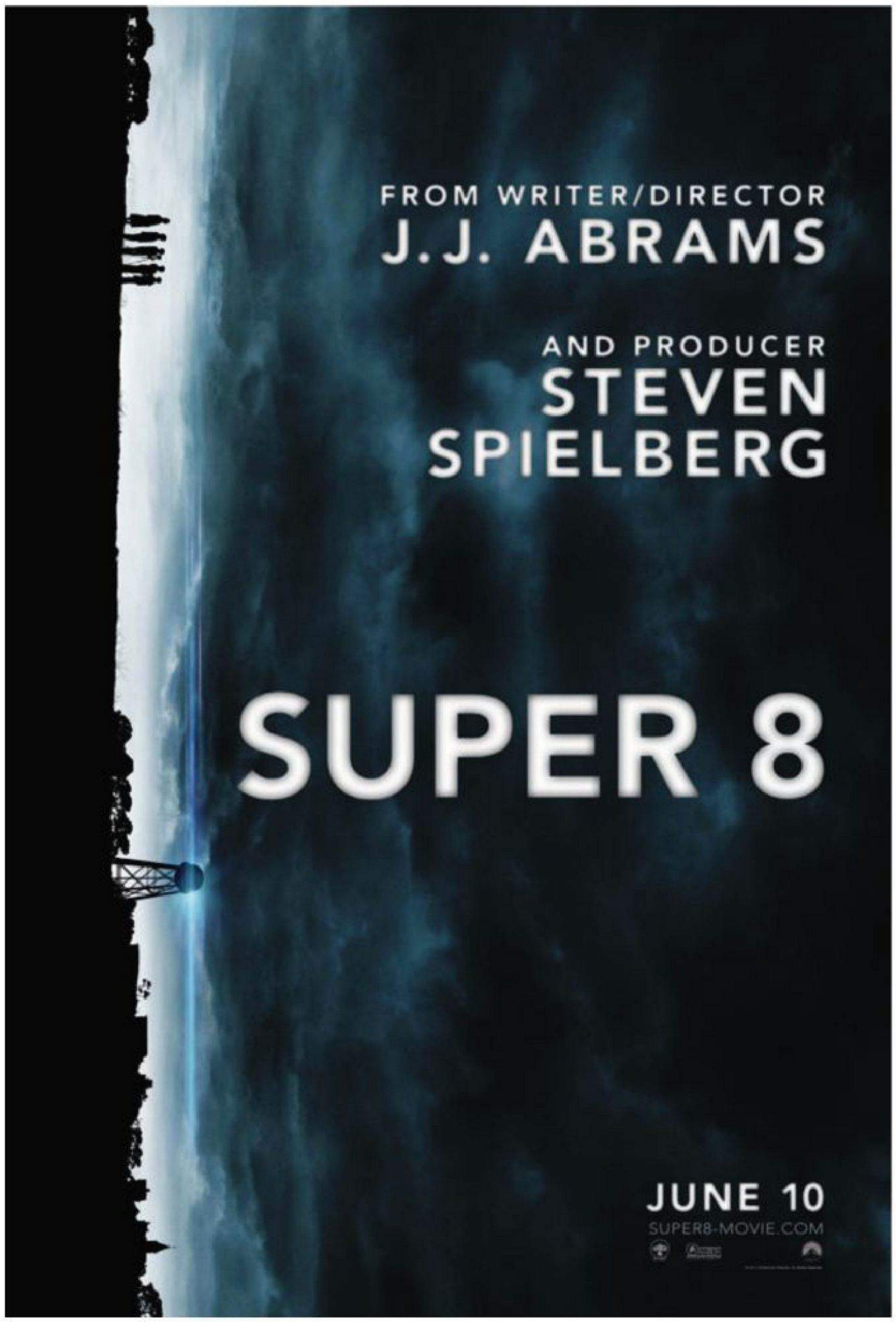
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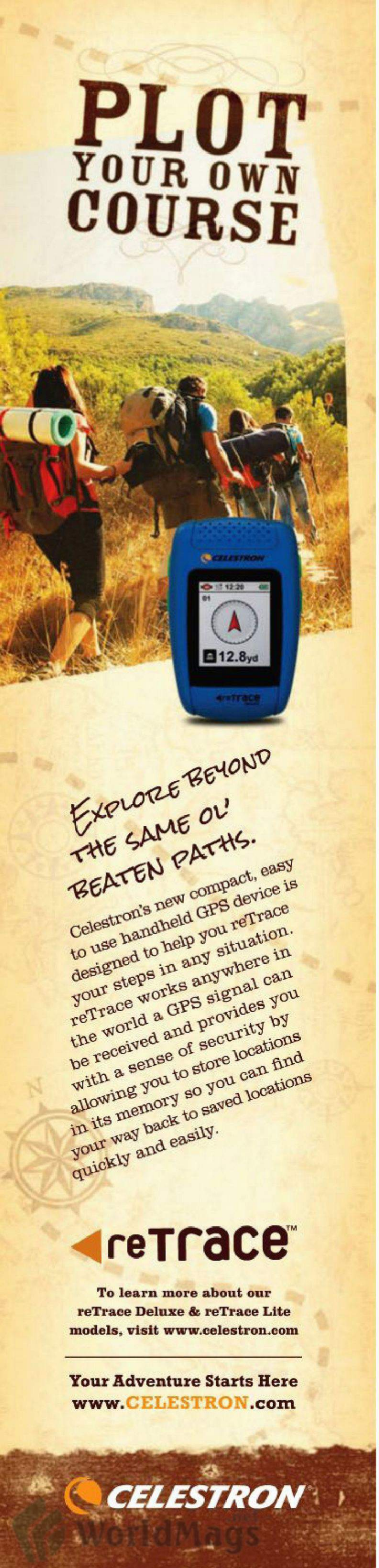
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the thief is smart enough to remove your SIM, it could foil your manhunt.

Of course, not everybody has an app-capable smartphone. If you've got an older phone, I suggest, at the very least, setting its lock screen to display your name and contact info and the promise of a reward for anybody who happens to stumble upon your phone. You'd be surprised how much of a motivator the promise of good karma and cash can be.

3D Sweet Spot

I'm assuming the glasses-free 3D display on the Nintendo 3DS game system has a sweet spot. How big is it, and what happens when I move outside it?

You're right. The glasses-free (or autostereoscopic, if you want to be fancy about it) display on the new Nintendo 3DS is a minor technological miracle, but its sweet spot is more of a viewfinder than an IMAX screen. I've been testing out the portable device, and have found that tilting your head or hand even a fraction of an inch is enough to make the screen go dark or turn into a blur. This doesn't necessarily make you dizzy or nauseated (even though Nintendo does advise users to rest their eyes with a whopping 10-minute break for every 30 minutes they spend staring at the screen)—it just kind of takes you out of the game, and could prove problematic for tasks that depend on precise hand–eye coordination.

One annoying result: The device could require hyperkinetic players, who may be used to dramatically dipping and diving their hands during excited gaming, to train themselves to cool their horses. I have also found that the 3D makes it very difficult for friends to comfortably watch a game over your shoulder.

Naming Our Tech World: **"messMS"**

The scenario: You are at a concert, a convention, a football game, any place the sheer number of people strains the local cell towers beyond their limits, and text messages just can't get through. Then, the minute your service returns to normal, a dozen or more texts flood in.

So, what do we call this phenomenon? No term currently exists, so I asked some of the best tech minds around for suggestions. Some of the better ideas included "suppressedMS," "textplosion" and "The SMS Bounty." Still, the best overall entry (as judged by the PM technology editors) was "messMS," which came from *Huffington Post* technology editor Bianca Bosker.

If you've come across a nameless tech phenomenon that you'd like to see us coin a phrase for, get in touch (contact info in the box at right), and we just might take it on.

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Fortunately, failing all else, the system has a dial that lets players turn down the 3D effect—or shut it off altogether. But, seriously, if you're going to do that, doesn't it kind of defeat the whole purpose of this thing?

iPad Flash

Is there any way to watch Flash videos on my iPad?

Yep, but it ain't pretty. Apple has drawn heaps of criticism for its decision to build the iPad as an Adobe Flash–resistant device, a deficiency that has carried over into the just-released iPad 2. The company's reasoning: The format can cause instability and serve as a security loophole for ne'er-do-wells. But while Apple's leviathan-like influence has caused a good portion of the Web to rebuild Flash sites into iPad-friendly formats such as HTML5, the iPad's Safari browser still stumbles upon a frustratingly large number of incompatible pages.

So the solution for the Flash-craving iPad user is, don't use Safari. A $5 third-party browser called Skyfire allows users to watch Flash videos right on their iPads. It works by transcoding the Flash content into HTML5 in the cloud and then pushing it out to the iPad.

This does present some potential problems. Because the browser is dependent on Skyfire's servers to convert the file, it can be a bit slow—or even completely inoperable—if an avalanche of users tries to pile on at once. (This happened when the company launched a similar Flash-reading Web browser for the iPhone in late 2010.) So, by all means take Skyfire for a spin, but don't be surprised if it isn't as smooth an experience as you're used to. **PM**

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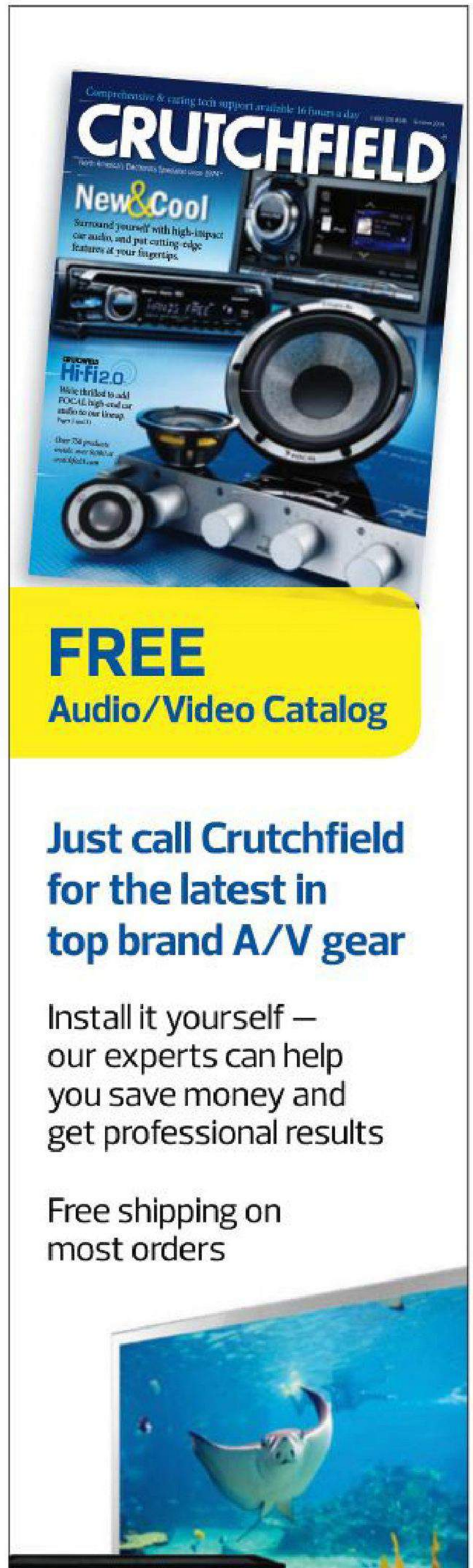
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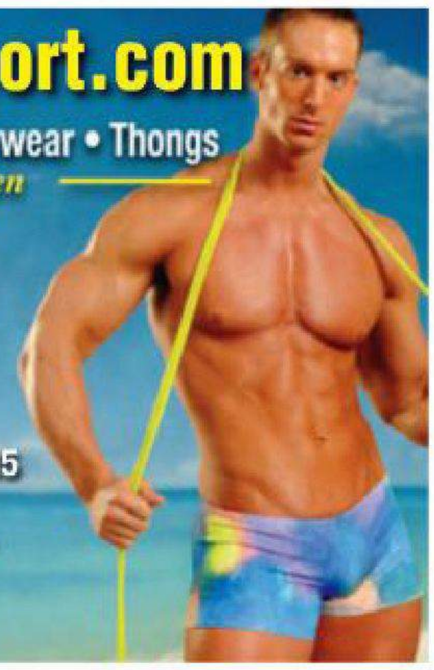
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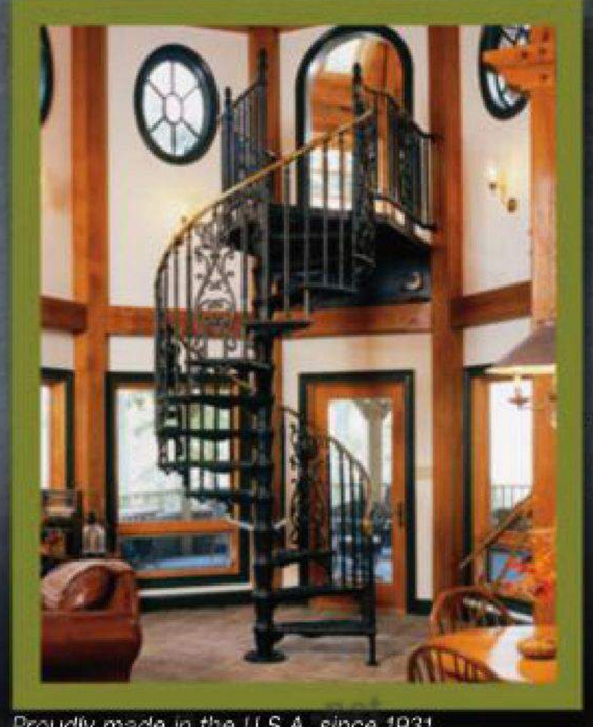
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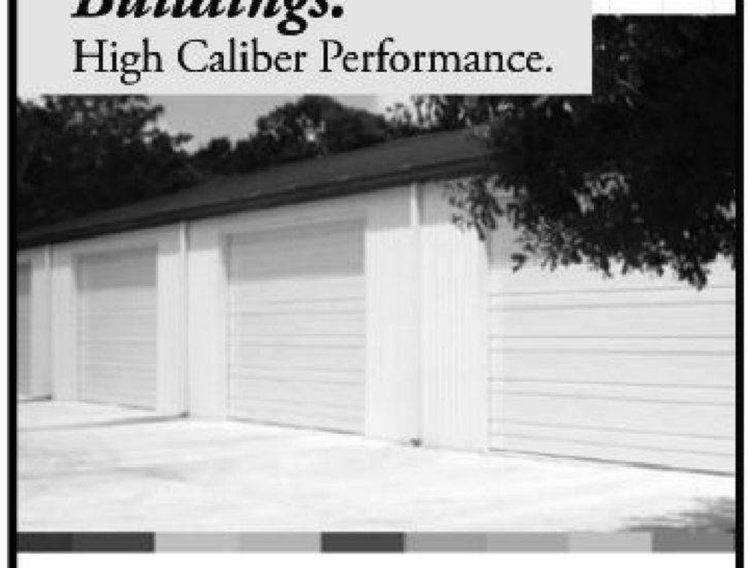
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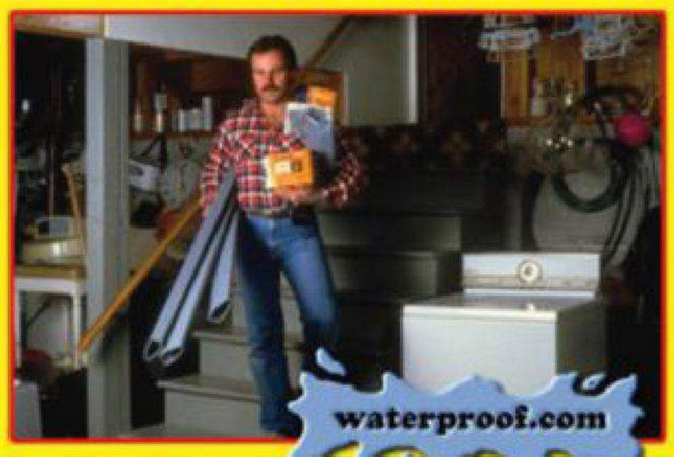
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When a script calls for an electrifying chase scene, filmmakers dial Lance Mayer. As co-founder of Monster Remotes, Mayer has rigged cameras to boats, motorcycles, ATVs and cars in movies such as *The Bourne Identity* and *I Am Legend*. To stabilize the image while enabling a camera to be operated remotely, Mayer relies on a special mount called the Libra head. He's one of only a handful of Libra technicians in the country. "There's always a chance you'll have problems when you're using electronics in adverse conditions," says Mayer, who has rigged the Libra to a crane near the North Pole and a Zodiac in the salty seas of the Caribbean. "I make sure everything is working so the director gets the shot he wants." — *SARAH SHATZ*

LIBRA HEAD TECHNICIAN

Name: LANCE MAYER
Location: NEW YORK, N.Y.
Age: 37
Years on Job: 6

1. CONTERRA RADIO CHEST HARNESS
Originally designed for rescue crews, Mayer's harness holds a xenon flashlight, a production radio, various wrenches and a Leatherman multitool. "There are certain tools I need to have on me at all times," Mayer says. "The vest makes them readily accessible."

2. LIBRA HEAD
The 60-pound Libra head is compatible with various cameras, including 16-mm, IMAX, HD, 3D and this 35-mm Panavision. A transmitter links to a 900-MHz point-to-point wireless system, which enables an operator to pan, tilt and roll the camera remotely. The Libra head can be programmed to record and repeat precise movements; its resistance to water and dust allow it to withstand extreme environments. And it's versatile: When a filmmaker needs to get tight shots through windows or doorways, Mayer converts the Libra into a 27-pound mini version and mounts it on a crane. He also uses the mini if the camera platform has weight restrictions—as would be the case with a Nascar vehicle traveling at 180 mph.

3. SCORPIO CRANE
In order to set up a sweeping shot or hard-to-capture angle for a cinematographer, Mayer attaches a Libra head and a camera to a telescoping crane, such as this Scorpio. The modular crane can extend from 5 to 23 feet.

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